User Manual

Model : VH-310C/G
VH-2MC/G
VH-4MC/G
VH-11MC/G
VH-16MC/G
VM series

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Revision History

Revision	Date	Descriptions
V1.0	2009.12.17	Initial release
V1.1	2010.04.12	Mechanical Spec modify
V1.2	2010.09.17	16M - $T_{3p\ modification\ :\ 600us\ ->\ 200us}$
V1.3	2010.11.05	New Name System

Contents

1. Precautions ---- 10
2. Compliance & Certifications ---- 10
2.1 FCC Declaration ---- 10
3. Package Contents ---- 11
Mount Plate (OPTION) ---- 13
CD 13
4. Installation ---- 14
4.1.1 PC Connection ---- 14
4.1.2 VM & VH Camera (Camera Link Interface) ---- 14
4.1.3 VH Camera - GigE Interface ---- 15
4.1.4 Mount Plate ---- 16
5. BFL (Back Focal Length) for different Mounts ---- 17
5.1.1 C-Mount ---- 17
5.1.2 F-Mount ---- 17
6. Overview ---- 18
6.1 VH Series Specification (Camera Link) ---- 19
6.2 VH Series Specification (GigE) ---- 20
6.3 Camera Block Diagram ---- 21
6.4 Sensor Information ---- 22
7. Camera Features ---- 24
7.1 Area Of Interest (AOI) ---- 24
7.2 Binning ---- 30
7.3 Exposure ---- 31
7.4 Trigger ---- 33
7.4.1 Trigger Input ---- 33
7.4.2 Trigger Mode ---- 35
7.4.2.1 Free-Run Mode 35
7.4.2.2 Standard Mode 37
7.4.2.3 Double Exposure 38
7.4.2.4 Fast Mode 40
7.4.2.5 Overlap Mode 41
7.4.3 Asynchronous Reset ---- 42
7.5 Channel Mode ---- 43
7.6 Gain and Offset ---- 45
7.7 LUT ---- 46
7.8 Defective Pixel Correction ---- 47

7.8.1 Correction Method ---- 47
7.9 Temperature Monitor ---- 48
7.10 Status LED ---- 48
7.11 Data Format ---- 49
7.12 Test Pattern ---- 50
7.13 Horizontal Flip ---- 52
7.14 Image Invert (Positive / Negative) ---- 53
7.15 Strobe ---- 54
7.15.1 Strobe Offset ---- 54
7.15.2 Strobe Polarity ---- 55
7.15.3 Strobe Output ---- 55
7.16 Field Upgrade ---- 55
8. Camera Configuration ---- 56
8.1 Setting Command ---- 56
8.2 Parameter Storage Spaces ---- 57
9. Command Set ---- 58
9.1 Readout Mode ---- 60
9.1.1 Set Readout Mode ---- 60
9.1.2 Get Readout Mode ---- 60
9.2 Area Of Interest ---- 61
9.2.1 Horizontal Area ---- 61
9.2.1.1 Set Horizontal Area 61
9.2.1.2 Get Horizontal Area 61
9.2.2 Vertical Area ---- 61
9.2.2.1 Set Vertical Area 61
9.2.2.2 Get Vertical Area 62
9.3 Binning Factor ---- 63
9.3.1 Set Binning Factor ---- 63
9.3.2 Get Binning Factor ---- 63
9.4 Exposure Time ---- 64
9.4.1 Set Exposure Time ---- 64
9.4.2 Get Exposure Time ---- 64
9.5 Channel Mode ---- 65
9.5.1 Set Channel Mode ---- 65
9.5.2 Get Channel Mode ---- 65
9.6 Trigger ---- 66
9.6.1 Trigger Mode ---- 66
9.6.1.1 Set Trigger Mode 66

9.6.1.2 Get Trigger Mode 66
9.6.2 Trigger Source ---------- 66
9.6.2.1 Set Trigger Source 66
9.6.2.2 Get Trigger Source 67
9.6.3 Frame Number ---------- 67
9.6.3.1 Set Frame Number 67
9.6.3.2 Get Frame Number 67
9.6.4 Exposure Source ---------- 68
9.6.4.1 Set Exposure Source 68
9.6.4.2 Get Exposure Source 68
9.6.5 Trigger Polarity ---------- 69
9.6.5.1 Set Trigger Polarity 69
9.6.5.2 Get Trigger Polarity 69
9.6.6 Asynchronous Reset ---------- 69
9.6.6.1 Set Async Reset 69
9.6.6.2 Get Async Reset 69
9.7 Analog Gain ---------- 71
9.7.1 Set Analog Gain ---------- 71
9.7.2 Get Analog Gain ---------- 71
9.8 Analog Offset ---------- 72
9.8.1 Set Analog Offset ---------- 72
9.8.2 Get Analog Offset ---------- 72
9.9 Data Bits ---------- 73
9.9.1 Set Data Bits ---------- 73
9.9.2 Get Data ---------- 73
9.10 Test Image ---------- 74
9.10.1 Set Test Image ---------- 74
9.10.2 Get Test Image ---------- 74
9.11 Defect Correction ---------- 75
9.11.1 Set Defect Correction ---------- 75
9.11.2 Get Defect Correction ---------- 75
9.12 LUT (Look-Up Table) ---------- 76
9.12.1 Set LUT Select ---------- 76
9.12.2 Get LUT Select ---------- 76
9.13 Flat Field Correction ---------- 77
9.13.1 Flat Field Data ---------- 77
9.13.1.1 Generate Flat Field Data 77
9.13.1.2 Save Flat Field Data 77

9.13.1.3 Load Flat Field Data 77
9.13.2 Flat Field Iteration ---- 77
9.13.2.1 Set Flat Field Iteration 77
9.13.2.2 Get Flat Field Iteration 78
9.13.3 Flat Field Correction ---- 78
9.13.3.1 Set Flat Field Correction 78
9.13.3.2 Get Flat Field Correction 78
9.13.4 Flat Field Offset ---- 79
9.13.4.1 Set Flat Field Offset 79
9.13.4.2 Get Flat Field Offset 79
9.14 Horizontal Flip ---- 80
9.14.1 Set Horizontal Flip ---- 80
9.14.2 Get Horizontal Flip ---- 80
9.15 Image Invert ---- 81
9.15.1 Set Image Invert ---- 81
9.15.2 Get Image Invert ---- 81
9.16 Strobe ---- 82
9.16.1 Strobe Offset ---- 82
9.16.1.1 Set Strobe Offset 82
9.16.1.2 Get Strobe Offset 82
9.16.2 Strobe Polarity ---- 82
9.16.2.1 Set Strobe Polarity 82
9.16.2.2 Get Strobe Polarity 82
9.17 Temperature Monitoring ---- 83
9.17.1 Get Camera Temperature ---- 83
9.18 Configuration ---- 83
9.18.1 Config Initialization ---- 83
9.18.1.1 Set Config Initialization 83
9.18.1.2 Get Config Initialization 83
9.18.1.3 Load Config From 84
9.18.1.4 Save Config To 84
9.19 Camera Information ---- 85
9.19.1 Get Model Number ---- 85
9.19.2 Get MCU Version ---- 85
9.19.3 Get FPGA Version ---- 85
10. VH Configurator ---- 86
10.1 Configurator GUI ---- 86
10.1.1 VH Camera Scan ---- 86

10.1.2 VH GigE Camera Scan ---------- 86
10.1.3 Menu ---------- 89
10.1.3.1 File 89
Load Setting : load the setting value of camera. Load from the setting value storage space(Factory, User1, User2) inside the camera or file in the user computer. ---------- 89
Save Setting : save setting value of camera. Save in setting value storage space(User1, User2) inside the camera or file in the computer. ---------- 89
Defect Pixel : download Defect information to camera (Download to Camera) or upload the Defect information saved in camera to user computer (Upload to PC). ---------- 89
System Upgrade : Upgrade MCU program or FPGA logic. ---------- 89
Exit : Exit the program. ---------- 89
10.1.3.2 Start-Up 90
Factory Setting : load the setting value from Factory space when camera is turned on. ---------- 90
User1 Setting : load the setting value from User1 space when camera is turned on. ---------- 90
User2 Setting : load the setting value from User2 space when camera is turned on. ---------- 90
10.1.3.3 Tool 91
Refresh : load and display the current setting value of camera on the program. ---------- 91
Terminal : display user command under GUI in terminal. Click to display terminal window on the bottom of program. Click again to hide Terminal window. ---------- 91
High Speed : operate in OverClock mode (50Mhz) when checked. If not checked, operates in Normal mode (40Mhz). (Except VH-V72model) ---------- 91
10.1.3.4 Help 92
Help : display the Help. Not supported currently. ---------- 92
Camera Info : display camera information (product name, serial number, version, etc.). ---------- 92
10.1.4 Tab 93
10.1.4.1 VIEW Tab 93
Mode : select Readout mode. If AOI is selected, right AOI setting area is activated, and AOI can be set with mouse drag or value input. If Binning is selected, x2, x4 selection is activated. ---------- 93
Test Image : select whether to apply test image and type of test image. ---------- 93
Data Bit : set width of data output. ---------- 93
Channel : set channel mode. ---------- 93
LUT : select whether to apply LUT and type of LUT. ---------- 93
Imaging Processing : set On/Off of Defect Correction, Image Invert, Horizontal Flip function (No Flat Field Correction function) ---------- 93
10.1.4.2 MODE/EXP Tab 94
Trigger Mode : set Trigger mode. As this mode is selected, related selection areas are activated. ---------- 94
Exposure : select Exposure source. ---------- 94
Source : select Trigger source. ---------- 94

Polarity : select polarity of Trigger input. ---------- 94
Async. Reset : set Async Reset On/Off ---------- 94
Frame Number ... : activated in Standard mode. Set the number of frame to receive after trigger input.------ 94
Exposure Time : set Exposure Time to be applied in Free-Run mode and when Exposure source is set with Program. ---------- 94
Strobe Offset : set Strobe Offset.---------- 94
Strobe Polarity : set polarity of Strobe output signal---------- 94
10.1.4.3 ANALOG Tab 95
Analog Gain : set Gain value of each channel. If Tap Link item is checked, setting values of both channels change together.---------- 95
Analog Offset : set Offsetvalue of both channels. If Tap Link item is checked, setting values of both channels change together. ---------- 95
10.1.4.4 LUT Tab 96
Graph : load LUT data from user file or set Gamma value to be applied when using Gamma curve. ---------- 96
LUT Download / Upload : download LUT data to camera from user computer (Download) or upload LUT data saved in camera to user computer (Upload to PC).---------- 96
11. GigaCam Installation and Use---------- 97
11.1 GigaCam Installation Method ---------- 97
11.1.1 Execute Install File ---------- 97
11.1.2 Continue InstallShield Wizard ---------- 97
11.1.3 Designate Install Directory ---------- 98
11.1.4 Select Setup Type (Recommended: Complete)---------- 98
11.1.5 Designate GeniCam Root Path(Click Next)---------- 99
11.1.6 Select BroadLinx Universal Filter Driver---------- 99
11.1.7 Select the target to install BroadLinx Universal Filter Driver ---------- 100
11.1.8 Select Continue if warning popup appears during installation---------- 100
11.1.9 Finish installation ---------- 101
11.1.10 Restart the system ---------- 101
11.1.11 Install VS2005 Redistribution Package---------- 102
11.1.11.1 Execute “scredist_x86.exe” 102
11.1.11.2 Click Yes (Completed) 102
11.1.11.3 If Syntax error occurs 102
11.2 Network Environment Setting ---------- 103
11.2.1 Change Network Connection Property---------- 103
11.2.2 Confirm after Changing Internet Protocol(TCP/IP) Property ---------- 104

11.2.3 Disable Firewall ---------- 105
11.2.3.1 Click Advanced Tab 105
11.2.3.2 Click Settings 106
11.2.3.3 Click off (not recommended) 107
11.2.4 Configure NIC Driver (Click Configure) ---------- 108
11.2.4.1 Set Jumbo Frame 109
11.2.4.2 Set Performance Option 110
11.2.4.3 Set Interrupt Moderation Rate at Extreme 111
11.2.4.4 Set Receive Descriptors at 2,048 112
11.3 GigaCam Use---------- 113
11.3.1 Execute GigaCam Program ---------- 113
11.3.2 Grabber configuration ---------- 114
11.3.3 Select Camera Connected, and Click Open Selected Device---------- 115
11.3.4 Open Video Streaming Window ---------- 116
11.3.4.1 Video 116
11.3.4.2 Tools 117
11.3.4.3 View 119
11.3.4.4 Options 120
11.3.4.5 Command 121
12. Mechanical Spec---------- 122
12.1 Specification of External Appearance ---------- 122
Appendix A Defective Pixel Map Download ---------- 124
Lines starting with ':' or '—' are processed as annotation. ---------- 124
Each line has horizontal coordinate and vertical coordinate in the order.---------- 124
It is not related to pixel input order.---------- 124
Appendix B LUT Download---------- 127
Lines starting with ':' or '—' are processed as annotation. ---------- 128
It should be recorded in the order of 0 to 4095 from input value. ---------- 128
Appendix C Field Upgrade ---------- 130

1. Precautions

General

- Do not drop or damage the device.
- Do not disassemble, repair or alter the device.
- Do not let children touch the device without supervision.
- Do not use the device for any other purpose than specified.
- Contact your nearest distributor in case of trouble or problem.

Installation & Maintenance

- Do not install the device in a place subject to direct sun light, humidity, dust or soot.
- Do not place magnets near the product.
- Do not place the device next to heating equipments.
- Be careful not to let liquid like water, drinks or chemicals leak inside the device.
- Clean the device often to remove dust on it.
- In clearing, do not splash water on the device but wipe it out with smooth cloth or towel.

Power Supply

It is recommended the use of 12V DC with ±10% of voltage, over 1A of output current with KC, CE or other local certification. (※ Vieworks Co., Ltd. DO NOT provide power supplies with the devices.)
If voltage over 16V is supplied, it will cause damages to the device.

2. Compliance & Certifications

2.1 FCC Declaration

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expenses.

2.2. CE : DoC

EMC Directive 2004/108/EC.

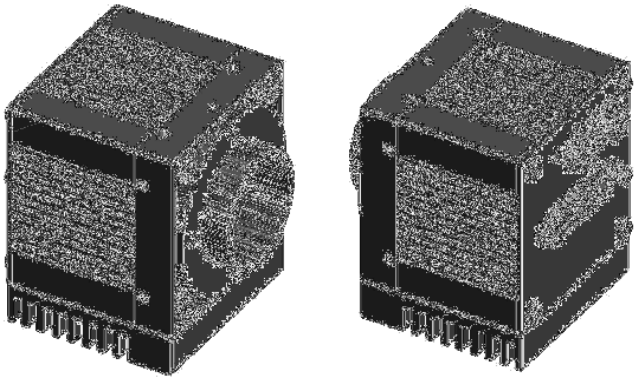
Testing Standard EN 55022:2006+A1:2007, EN 55024:1998+A1:2001+A2:2003

Class A

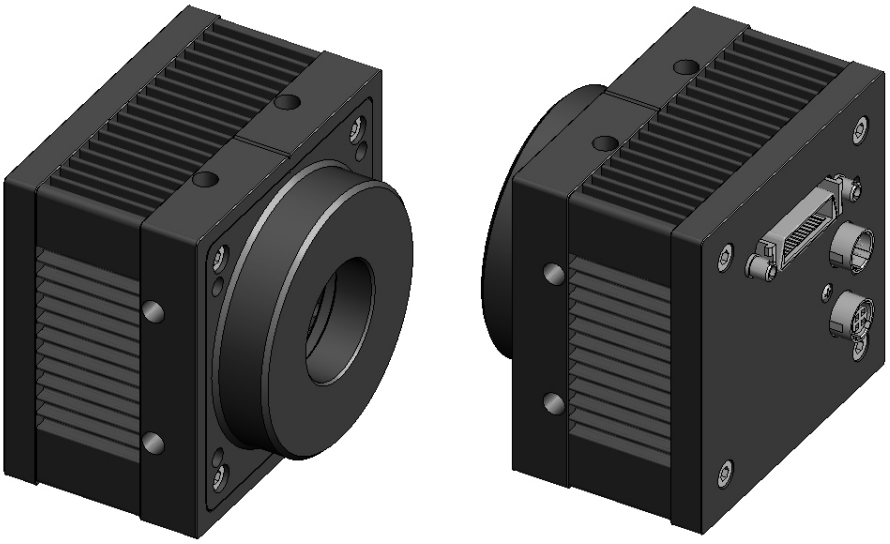
3. Package Contents

- Camera (1 unit)

VH-310C(C-Mount) - Camera Link

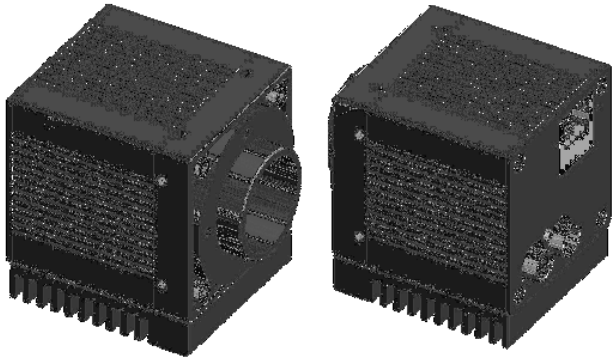


VM & VH Camera (C-Mount) - Camera Link



VM & VH Camera (F-Mount) - Camera Link

VH-310G(C-Mount) - GigE Interface



VH Camera (C-Mount) - GigE Interface

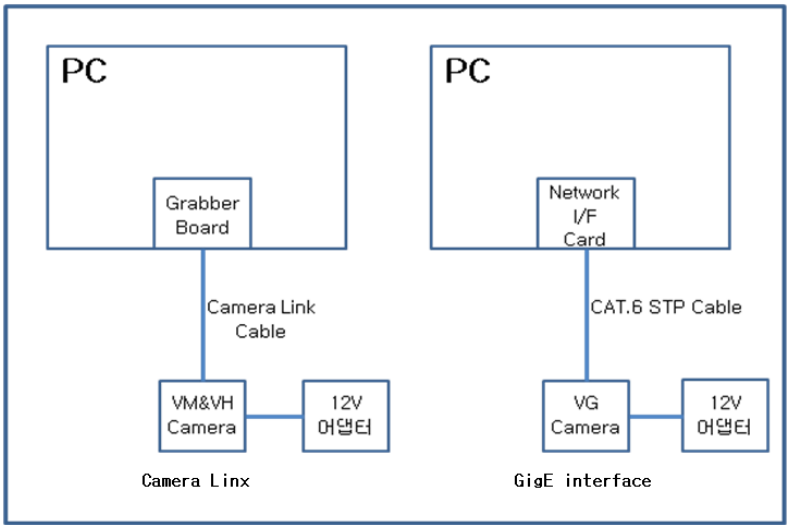
VH Camera (F-Mount) – GigE Interface

Mount Plate (OPTION)

CD

4. Installation

4.1.1 PC Connection



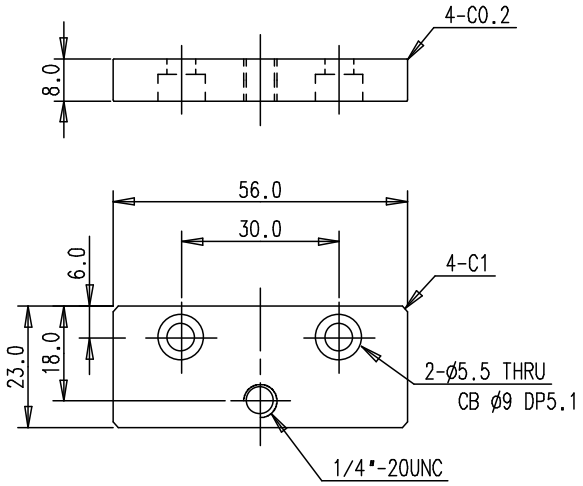
4.1.2 VM & VH Camera (Camera Link Interface)

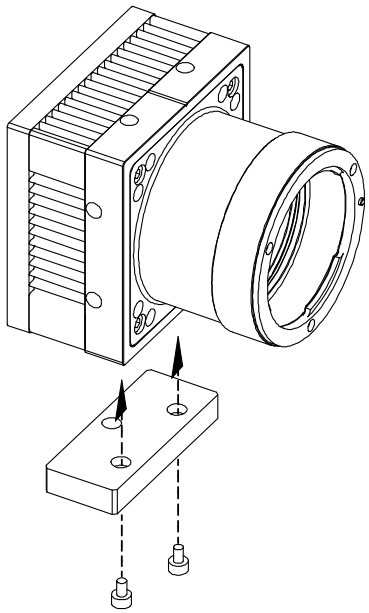
- Camera Link Cable Connection
- Power Cable Connection
- Control Cable Connection

4.1.3 VH Camera - GigE Interface

- RJ45 Cable Connection
- Power Cable Connection
- Control Cable Connection

4.1.4 Mount Plate

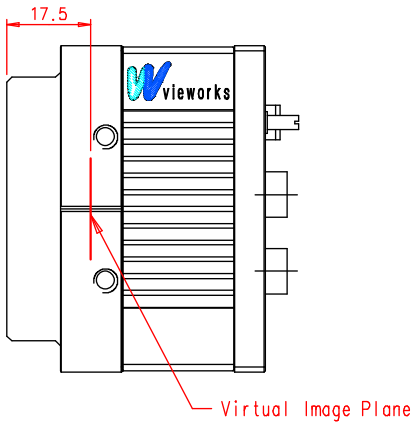




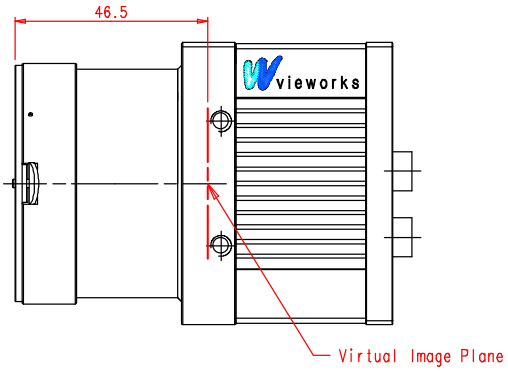
- The Mount Plate is provided as Option.
- The camera can be fix without using this Mount Plate.

5. BFL (Back Focal Length) for different Mounts

5.1.1 C-Mount



5.1.2 F-Mount



6. Overview

The VH Series of cameras are Progressive Scan, high-resolution industrial Area Scan cameras. All functions of VH cameras can be programmed and updated in the field. Image processing and control of VH cameras are based on embedded FPGA with a 32 bit microprocessor.

Main Features

- Area Of Interest
- Trigger Mode
- Binning Mode – 2x2 / 4x4
- Output Width – 8 / 10 / 12 bit
- Output channel – Single / Dual (VH-310G-72 Single Only)
- Electronic Shutter
- Strobe Output
- Analog Gain adjustment function
- Analog Offset adjustment function
- Look Up Table
- Defective Pixel correction
- Test Image
- Horizontal Flip
- Image Invert
- RS-644 Serial Communication
- Temperature Monitor
- Field Upgrade
- Base Camera Link [VH (Camera Link) Series]
- Gigabit Ethernet [VH (GigE) Series]

6.1 VH Series Specification (Camera Link)

	VH-310C	VH-2MC	VH-4MC	VH-11MC	VH-16MC
Active Image	640(H)×480(V)	1600(H)×1200(V)	2048(H)×2048(V)	4008(H)×2672(V)	4872(H)×3248(V)
Pixel Clock	50 MHz	50 MHz	50 MHz	40 MHz	40 MHz
Pixel size	7.4 ㎛ ×7.4 ㎛	7.4 ㎛ ×7.4 ㎛	7.4 ㎛ ×7.4 ㎛	9.0 ㎛ * 9.0 ㎛	7.4 ㎛ ×7.4 ㎛
Video Output	8/10/12 bits, 1 or 2 Tap				
Camera I/F	Base Camera Link				
Max. Frame Rate	264 fps (dual) 140 fps (single)	42 fps (dual) 23 fps (single)	20 fps(dual) 11 fps(single)	6.4 fps(dual) 3.4 fps(single)	4.2 fps(dual) 2.3 fps(single)
Exposure Time	1/40000s ~ 7s (10 us step)	1/20000s ~ 7s (10 us step)	1/14000s ~ 7s (10 us step)	1/7000s ~ 7s (10 us step)	1/4500s ~ 7s (10 us step)
Partial Scan	1290 fps at 60 Lines (max. speed)	146 fps at 150 Lines (max. speed)	77 fps at 256 Lines (max. speed)	30 fps at 334 Lines (max. speed)	12 fps at 406 Lines (max. speed)
Gamma Correction	User defined LUT (Look Up Table)				
Black Offset	Adjustable (0~255 LSB at 12 bit)				
Video Gain	Analog: 0 ~ 32 dB, 900 step				
Trigger Mode	Mode(free run , standard, fast, double, overlap)				
Ext. Trigger	External, 3.3V - 5.0V, 10mA, optically isolated				
S/W Trigger	CC1, programmable expose				
S/N Ratio	> 62 dB	> 62 dB	> 62 dB	> 62 dB	> 62 dB
Lens Mount	C-mount	C-mount, F-mount optional			
Power	10~14V DC , MAX. 8W				
Environmental	-5℃~+40℃, storage :-30℃~65℃				
Mechanical	49x49x52.8mm 190g (C-mount)	68x68x54mm, 420g (C-mount) 68x68x83mm, 460g (F-mount)			

6.2 VH Series Specification (GigE)

	VH-310G-72	VH-310G-264	VH-2MG	VH-4MG	VH-11MG	VH-16MG
Active Image	640(H)×480(V)	640(H)×480(V)	1600(H)×1200(V)	2048(H)×2048(V)	4008(H)×2672(V)	4872(H)×3248(V)
Pixel Clock	30 MHz	50 MHz	50 MHz	50 MHz	40 MHz	40 MHz
Pixel size	9.0 ㎛ ×9.0 ㎛	7.4 ㎛ ×7.4 ㎛	7.4 ㎛ ×7.4 ㎛	7.4 ㎛ ×7.4 ㎛	9.0 ㎛ * 9.0 ㎛	7.4 ㎛ ×7.4 ㎛
Video Output	8/10/12 bits, 1 Tap	8/10/12 bits, 1 or 2 Tap				
Camera I/F	Gigabit Ethernet					
Max. Frame Rate	72 fps (single)	264 fps (dual) 140 fps (single)	42 fps (dual) 23 fps (single)	20 fps(dual) 11 fps(single)	6.4 fps(dual) 3.4 fps(single)	4.2 fps(dual) 2.3 fps(single)
Exposure Time	1/40000s ~ 7s (10 us step)	1/40000s ~ 7s (10 us step)	1/20000s ~ 7s (10 us step)	1/14000s ~ 7s (10 us step)	1/7000s ~ 7s (10 us step)	1/4500s ~ 7s (10 us step)
Partial Scan	215 fps at 100 Lines (max. speed)	930 fps at 100 Lines (max. speed)	146 fps at 150 Lines (max. speed)	77 fps at 256 Lines (max. speed)	30 fps at 334 Lines (max. speed)	12 fps at 406 Lines (max. speed)
Gamma Correction	User defined LUT (Look Up Table)					
Black Offset	Adjustable (0~255 LSB at 12 bit)					
Video Gain	Analog: 0 ~ 32 dB, 900 step					
Trigger Mode	Mode (free run , standard, fast, double, overlap)					
Ext. Trigger	External, 3.3V - 5.0V, 10mA, optically isolated					
S/N Ratio	> 57 dB	> 62 dB	> 62 dB	> 62 dB	> 62 dB	> 62 dB
Lens Mount	C-mount		C-mount, F-mount optional			
Power	10~14V DC , MAX. 10W					
Environmental	-5℃~+40℃, storage :-30℃~65℃					
Mechanical	49x49x61.4mm 210g (C-mount)		68x68x62.1mm, 455g (C-mount) / 68x68x91.1mm, 495g (F-mount)			

6.3 Camera Block Diagram

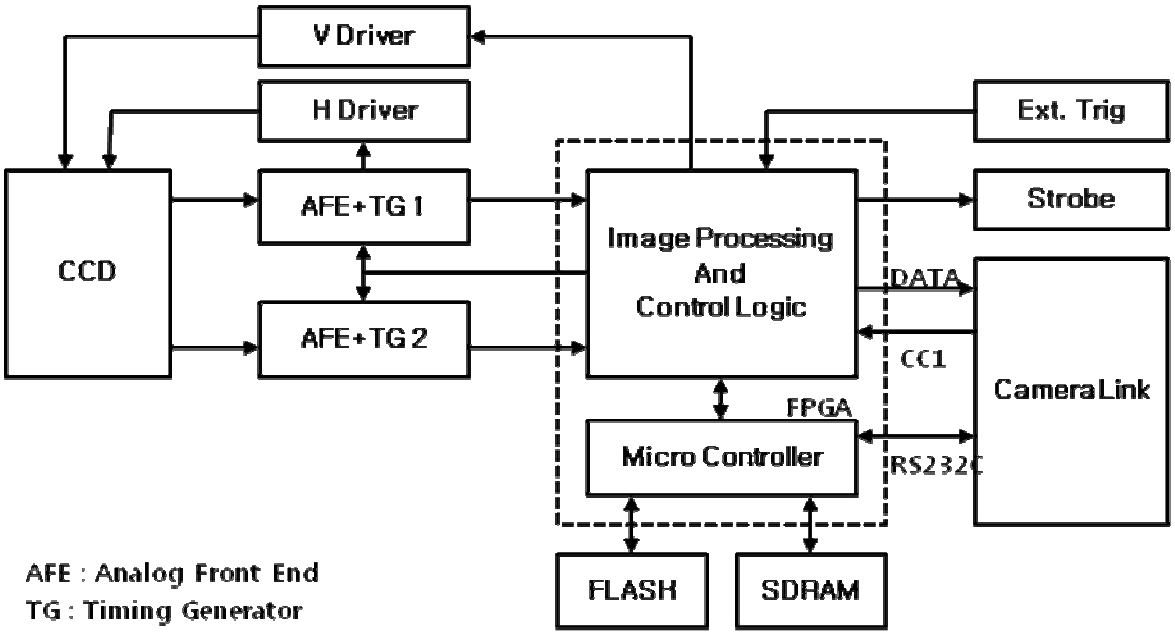


Fig. 6.1 VH (Camera Link) Series Camera Block Diagram

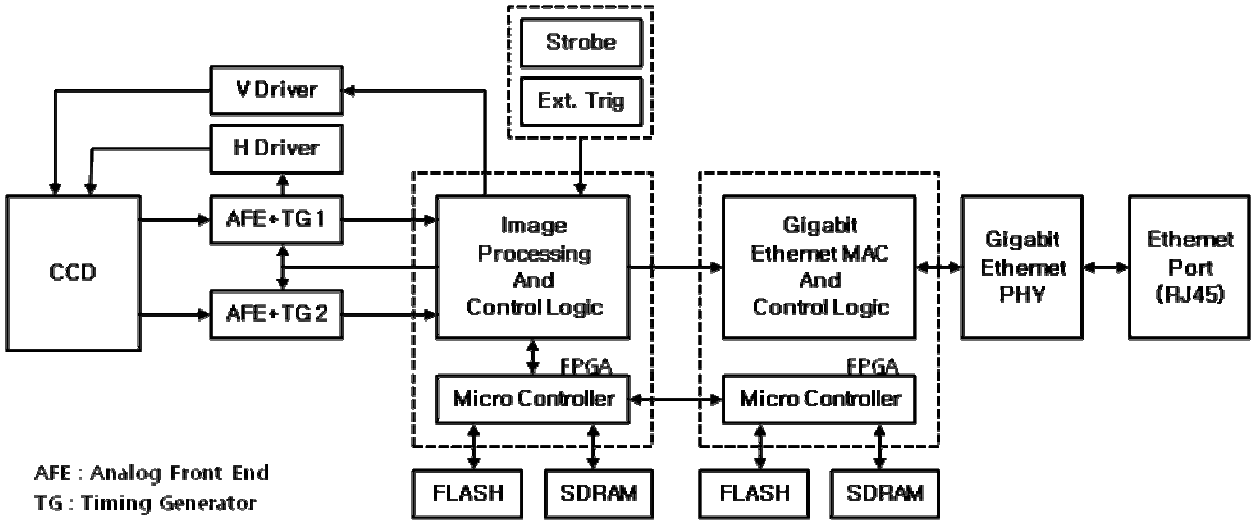


Fig. 6.2 VH (GigE) Series Camera Block Diagram

All control and data processing of VH cameras are carried out in one FPGA chip. The FPGA has a 32 bit RICS microprocessor with processing & control logic. The microprocessor processes commands from the user through the Camera Link interface. The FPGA controls the AFE (Analog Front End) chips that converts the pixel values in the ADC (Analog Digital Convertor) to digital. The FPGA provides the timing to the CCD through the Timing Generator. Image data received through AFE, is processed by the FPGA and sent to through the CameraLink interface. The FPGA receives the trigger input and generates the strobe output, making sure the latency is very low. SDRAM is used for image frame buffering and FLASH contains the firmware that is used to operate the micro-controller.

6.4 Sensor Information

Camera uses Kodak CCD as image sensor. After exposure for certain period of time, the electric charges accumulated on each pixel of CCD move to Vertical Register (VCCD) by control signal and then to Horizontal Register (HCCD) by vertical control signal, line by line. Electric charges accumulated on HCCD are sent after being converted to voltage value for each pixel by horizontal control signal. At this time, it can be simultaneously output to single direction (Video L) or both directions (Video L and Video R) depending on horizontal signal approved.

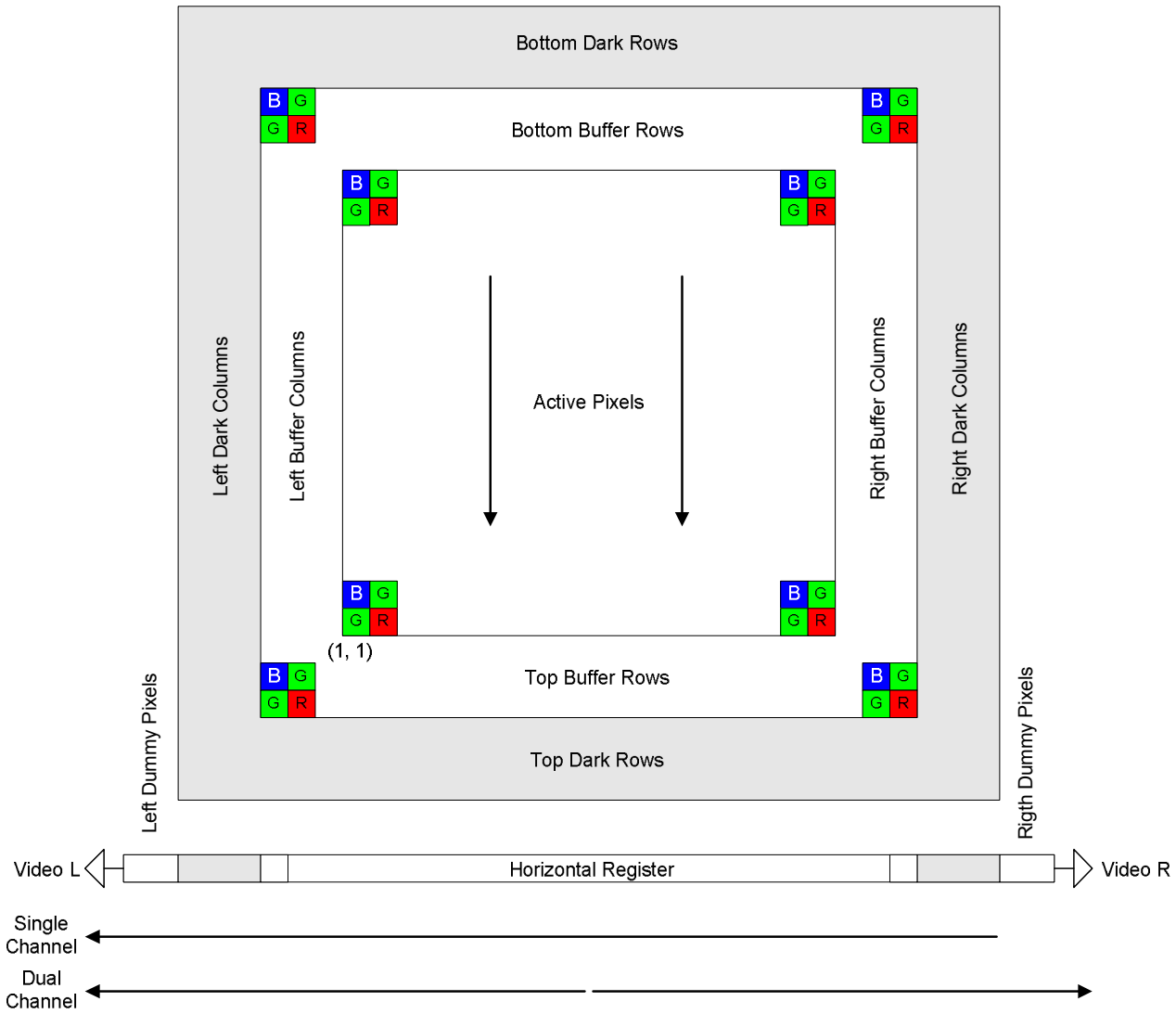


Fig. 6.3 CCD Sensor Architecture

Specification of sensor for each model of VH camera is as shown in Table 6.1.

Camera Model	VH-310G-72	VH -310C/G-264	VH-2MC/G
CCD Sensor	KAI-0330	KAI-0340	KAI-2020
Pixel Size(H x V)	9.0um x 9.0um	7.4um x 7.4um	7.4um x 7.4um
Left Dummy Pixels	1	12	4
Left Black Columns	24	24	16
Left Buffer Columns	4	4	4
Active Pixels (H)	640	640	1600
Right Buffer Columns	4	4	4
Right Black Columns	8	24	16
Right Dummy Pixels	4	12	4
Top Dark Rows	4	4	2
Top Buffer Rows	2	4	4
Active Pixels (V)	480	480	1200
Bottom Buffer Rows	2	4	4
Bottom Dark Rows	8	0	4
Camera Model	VH-4MC/G	VH-11MC/G	VH-16MC/G
CCD Sensor	KAI-4021	KAI-11002	KAI-16000
Pixel Size(H x V)	7.4um x 7.4um	9.0um x 9.0um	7.4um x 7.4um
Left Dummy Pixels	12	4	12
Left Black Columns	28	20	28
Left Buffer Columns	4	12	16
Active Pixels (H)	2048	4008	4872
Right Buffer Columns	4	13	16
Right Black Columns	28	19	28
Right Dummy Pixels	12	4	12
Top Dark Rows	10	17	40
Top Buffer Rows	6	8	16
Active Pixels (V)	2048	2672	3248
Bottom Buffer Rows	8	8	16
Bottom Dark Rows	0	16	4

Table 6.1 CCD Information

7. Camera Features

7.1 Area Of Interest (AOI)

AOI is the area containing the data required by the user within the entire image. The user can obtain the image faster with the same high quality as when obtaining overall areas by designating the area as AOI. AOI is determined as the overlapping area of 2 areas when designating Start point and End point in horizontal and vertical directions as shown in Fig. 7.1. Start point and End point mean the starting and end of the AOI. The narrower Vertical AOI gets, the faster the frame speed. But Horizontal AOI does not affect frame speed.

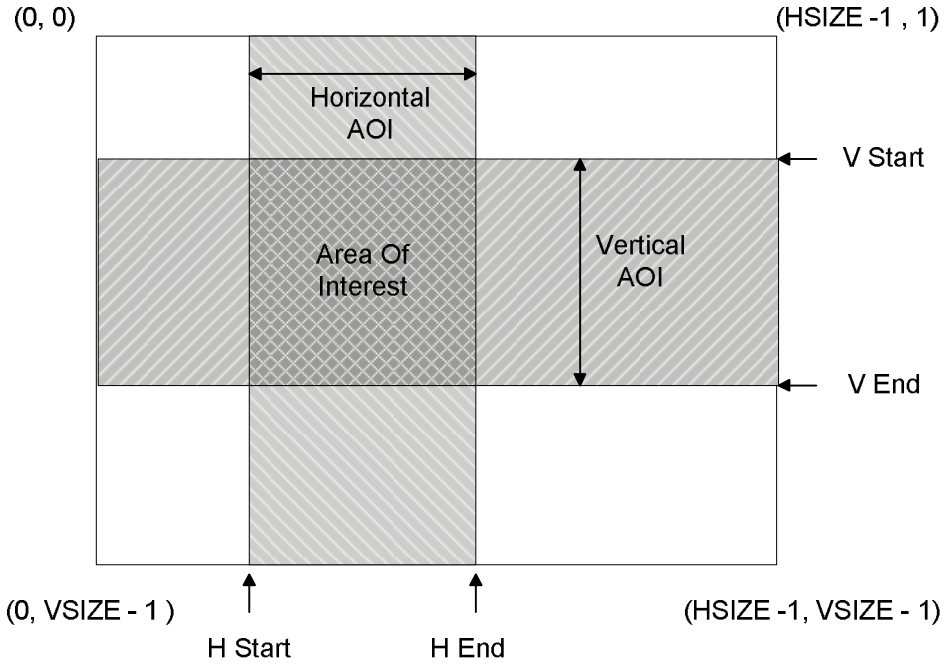


Fig. 7.1 AOI

Maximum frame speed depending on change of Vertical AOI can be obtained as shown in the following expression.

Frame Rate (fps) = 1000000 / (T_{VCCD} + T_{FD} x (VSIZE – VAOI) + VAOI x T_L)

T_{VCCD} : time required to move electric charges accumulated on pixel to Vertical Register

T_{FD} : time required for Fast Dump

VSIZE : number of Vertical Line of CCD

T_L : time required for transmission of one line

VAOI : size of Vertical AOI

Minimum value of T_{VCCD}, T_{FD}, VSIZE, T_L, and VAOI that can be set differs depending on camera model. The value of T_L differs depending on channel mode. The value of each item depending on model and the timing relationship is shown below:

Camera Model	VH-310G-72	VH-310C/G-264	VH-2MC/G
T_{VCCD}	26us	35.3us	97.0us
T_L (single channel)	27.1us	15.1us	44.1us
T_L (dual channel)	-	8.1us	23.6us
T_{FD}	5.0us	0.6us	3.0us
VSIZE	480 lines	480 lines	1200 lines
VAOI $_{MIN}$	100 lines	60/100 lines	150 lines
Camera Model	VH-4MC/G	VH-11MC/G	VH-16MC/G
T_{VCCD}	139.6us	190.0us	242.0us
T_L (single channel)	56.1us	106.8us	135.0us
T_L (dual channel)	29.7us	55.9us	73.0us
T_{FD}	3.0us	6.0us	16.0us
VSIZE	2048 lines	2672 lines	3248 lines
VAOI $_{MIN}$	256 lines	334 lines	406 lines

Table 7.1 Setting Value per Model

Table 7.2 shows maximum and minimum value of Start and End value that can be set for each model. VSIZE , $VAOI_{MIN}$ shows the setting value of relevant model in Table 7.1.

Camera Model	VH-310G-72	VH-310C/G-264	VH-2MC/G
$HSTART_{MIN}$	0	0	0
$HSTART_{MAX}$	639	639	1599
$HEND_{MIN}$	0	0	0
$HEND_{MAX}$	639	639	1599
$VSTART_{MIN}$	0	0	0
$VSTART_{MAX}$	VSIZE - $VAOI_{MIN}$	VSIZE - $VAOI_{MIN}$	VSIZE - $VAOI_{MIN}$
$VEND_{MIN}$	$VAOI_{MIN}$ - 1	$VAOI_{MIN}$ - 1	$VAOI_{MIN}$ - 1
$VEND_{MAX}$	479	479	1199
Camera Model	VH-4MC/G	VH-11MC/G	VH-16MC/G
$HSTART_{MIN}$	0	0	0
$HSTART_{MAX}$	2047	4007	4871
$HEND_{MIN}$	0	0	0
$HEND_{MAX}$	2047	4007	4871
$VSTART_{MIN}$	0	0	0
$VSTART_{MAX}$	VSIZE - $VAOI_{MIN}$	VSIZE - $VAOI_{MIN}$	VSIZE - $VAOI_{MIN}$
$VEND_{MIN}$	$VAOI_{MIN}$ - 1	$VAOI_{MIN}$ - 1	$VAOI_{MIN}$ - 1
$VEND_{MAX}$	2047	2671	3247

Table 7.2 Start and End Setting Value per Model

Graphs from Fig. 2.2 to Fig. 2.7 show the change in maximum frame speed according to Vertical AOI for each model using the above expression.

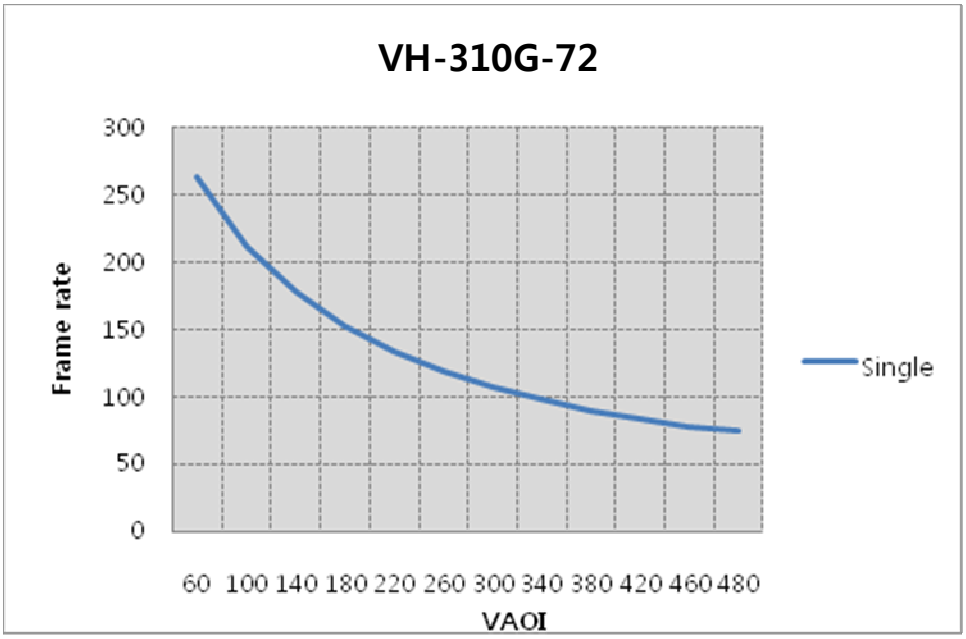


Fig. 7.2 Frame Rate Change by VAOI of VH-310G-72

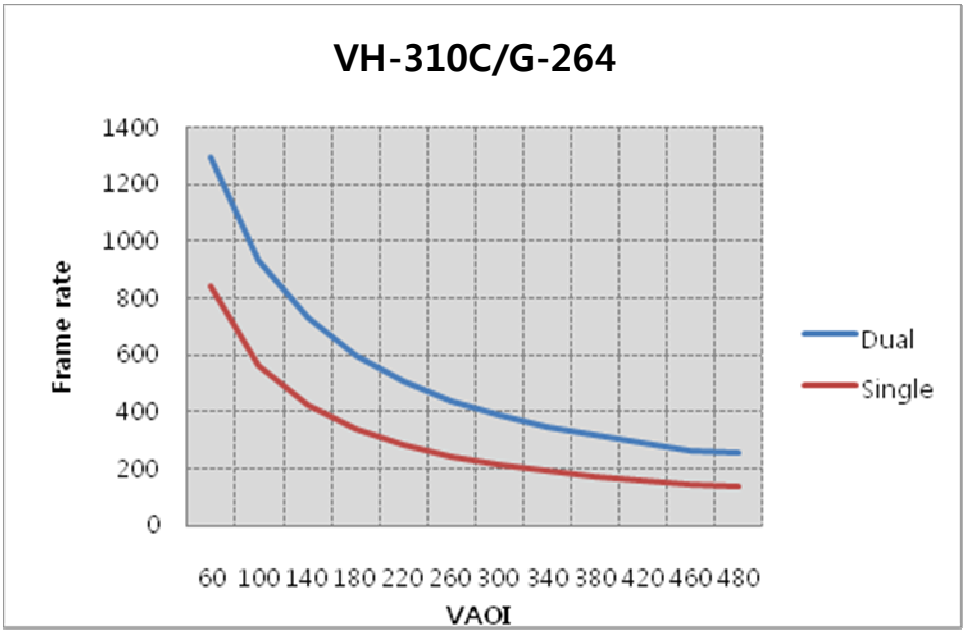


Fig. 7.3 Frame Rate Change by VAOI of VH-310C/G-264

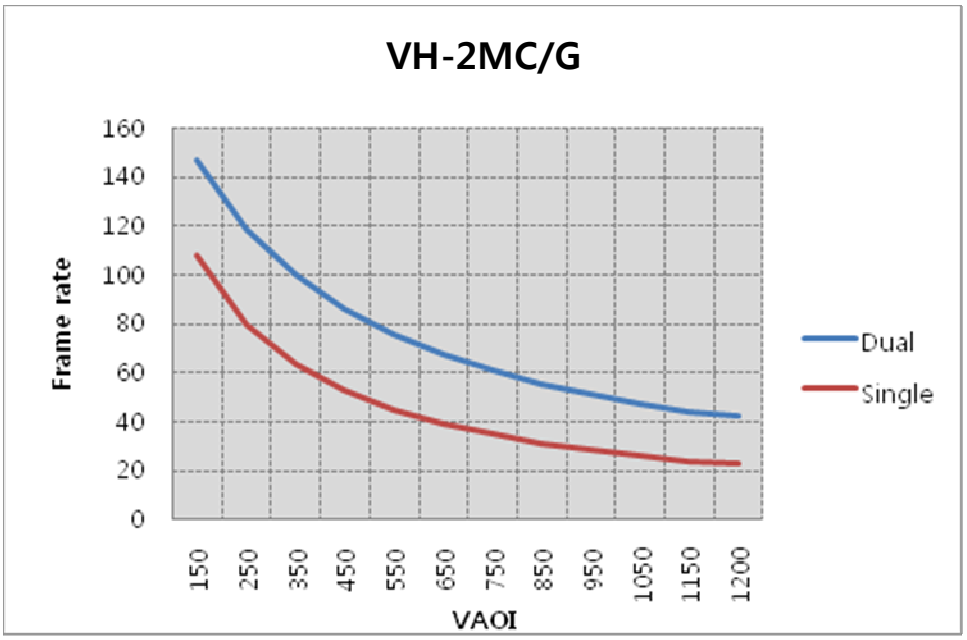


Fig. 7.4 Frame Rate Change by VAOI of VH-2MC/G

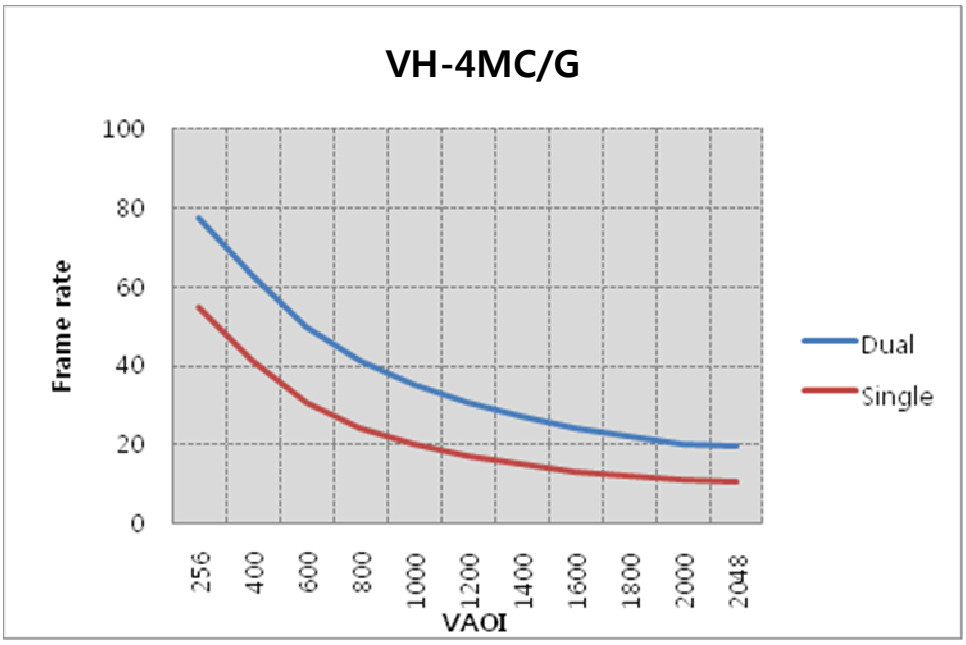


Fig. 7.5 Frame Rate Change by VAOI of VH-4MC/G

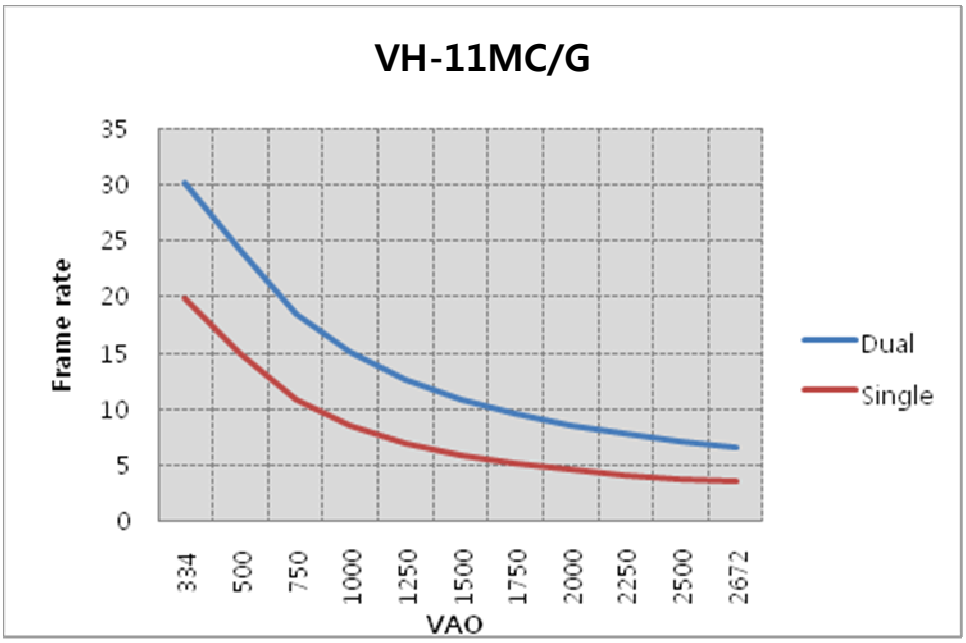


Fig. 7.6 Frame Rate Change by VAOI of VH-11MC/G

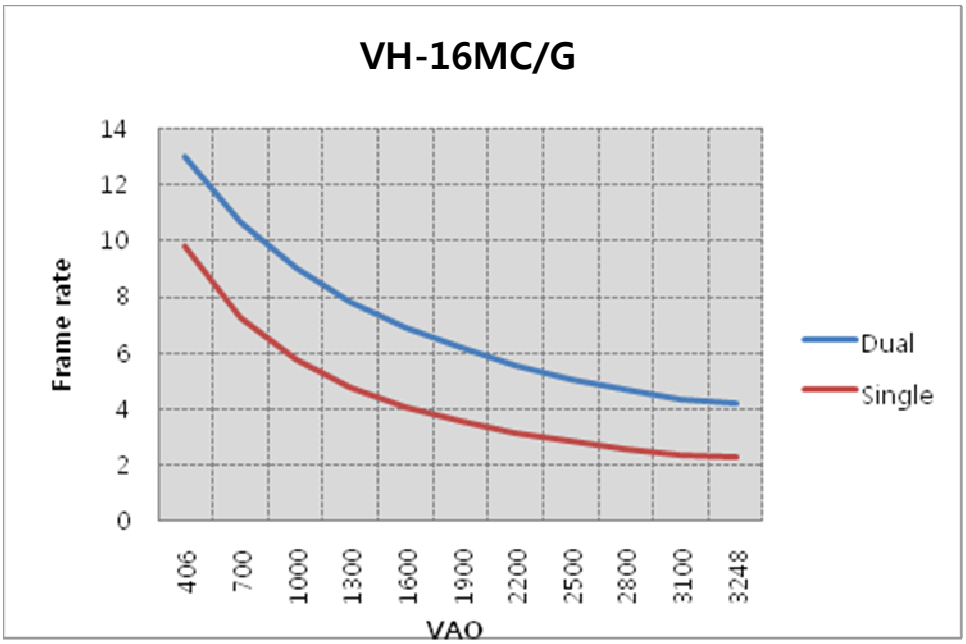


Fig. 7.7 Frame Rate Change by VAOI of VH-16MC/G

7.2 Binning

Binning has the effect of increasing the available pixel well capacity and decreasing resolution by adding the value of an adjacent pixel and sending them as one pixel. The camera applies the same Binning Factor (2 or 4) to both directions in order to maintain the aspect ratio of the full resolution image. Fig. 7.8 and Fig. 7.9 show application of 2x2 Binning and 4x4 Binning, respectively. Since Binning in the vertical direction is processed within the shielded vertical registers of the CCD, the frame speed increases by the Binning Factor approximately (2X or 4X). Binning in the horizontal direction does not affect frame speed. Binning Factor is set using the “sbf” command. (See 9.3 Binning Factor)

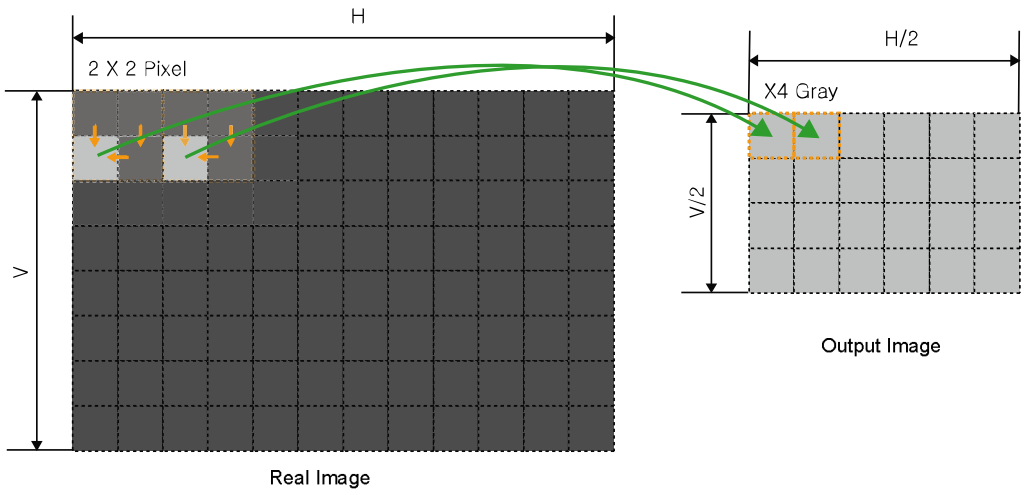


Fig. 7.8 2x2 Binning

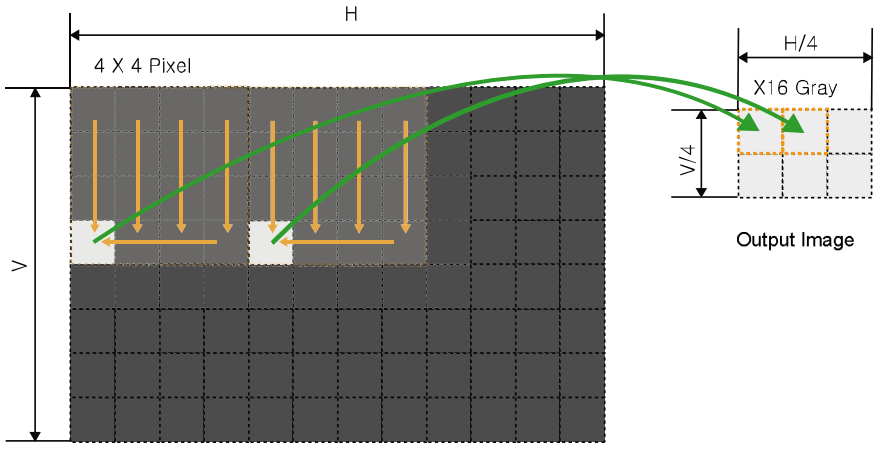


Fig. 7.9 4x4 Binning

7.3 Exposure

Exposure time of camera is adjusted by shutter signal. Shutter signal is the signal that removes the electric charge accumulated on CCD pixel until shutter signal is generated, and accumulates the electric charge thereafter. Therefore, Exposure Time of camera is determined at the interval between shutter signal and VCCD signal. Since actual VCCD signal consists of 2 level waveforms as shown in the following Fig. 7.10, Exposure Time is the time from downward edge of Shutter signal to high level downward edge of VCCD signal.

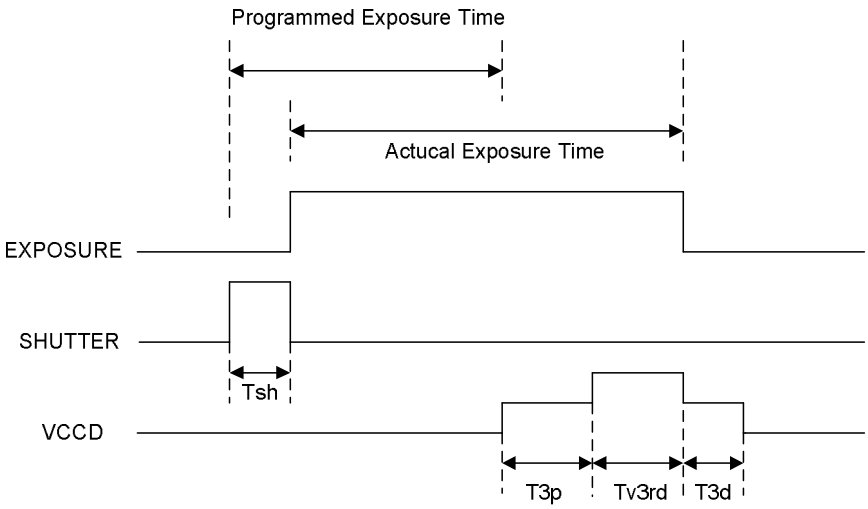


Fig. 7.10 Exposure Time

"set" command is used to set Exposure Time. (See 9.4 Exposure Time). Available minimum value is 10us and maxim value can be set up to 7s. However, it should be noted that Exposure Time set with "set" command is the time from starting point of shutter signal to starting point of VCCD signal, and slightly differs from Exposure Time actually applied. As shown in Fig. 7.10, relation between exposure time set and that actually applied are as follows:

Actual Exposure Time = Programmed Exposure Time + T3p + Tv3rd – Tsh

Since T3p, Tv3rd and Tsh are the factors determined by CCD used, difference between Exposure Time actually applied and Exposure Time set in advance differs depending on camera model.
See following Table **7.3** for Tsh, T3p, Tv3rd for each model.

Camera Model	VH-310G-72	VH-310C/G-264	VH-2MC/G
T_{sh}	1.0us	1.0us	1.0us
T_{3p}	1.0us	15.0us	25.0us
T_{v3rd}	5.0us	0.4us	12.0us
Camera Model	VH-4MC/G	VH-11MC/G	VH-16MC/G
T_{sh}	1.0us	5.5us	5.5us
T_{3p}	60.0us	120.0us	200.0us
T_{v3rd}	5.0us	20.0us	12.0us

Table 7.3 Time Value by Model

7.4 Trigger

7.4.1 Trigger Input

2 kinds of sources can be used as trigger input: CC1 port (CC1+, CC1-) of Camera Link interface and TRIGGER_IN port (TRIGGER_IN+, TRIGGER_IN-) of power connector. TRIGGER_IN port is separated from inside of camera by Opto Coupler and has 470 Ohm resistance inside to restrict the current. TRIGGER signal is used inside FPGA through Inverting.

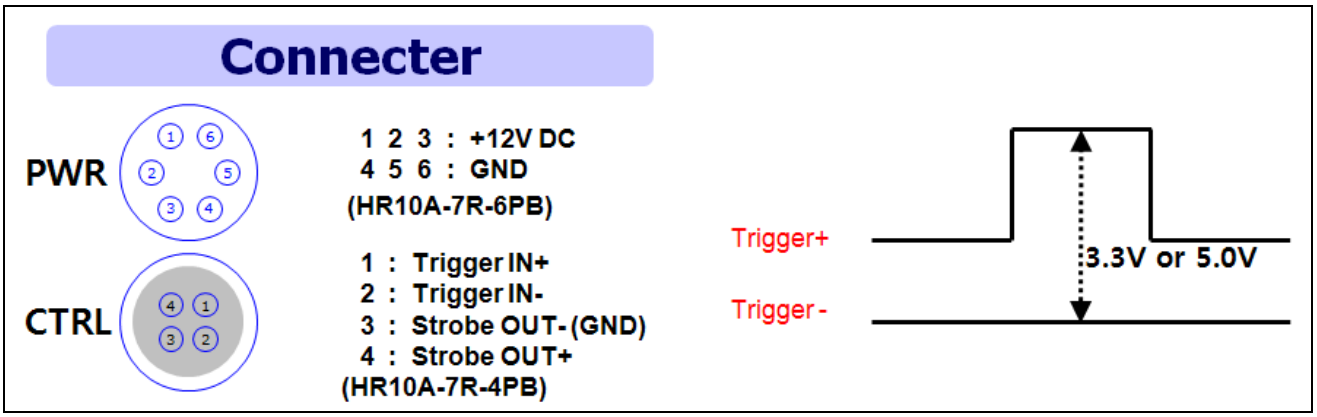


Fig. 7.11 Trigger Connection

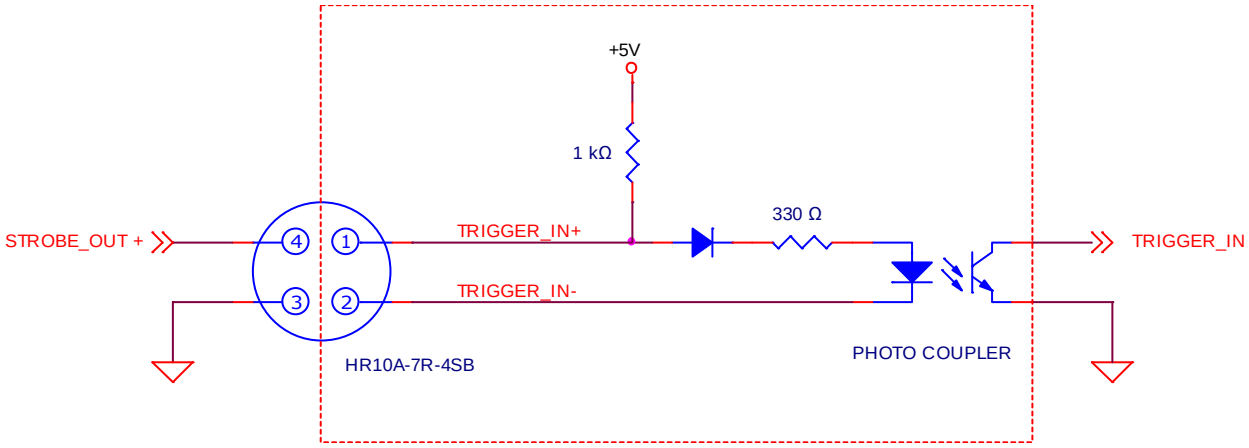


Fig. 7.12 Trigger Input Circuit

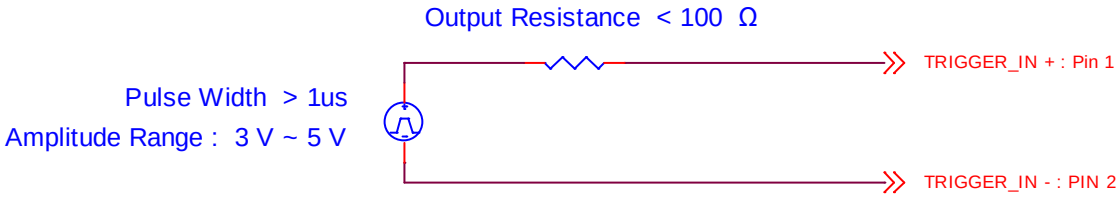


Fig. 7.13 Recommended Pulse Trigger Driver Input

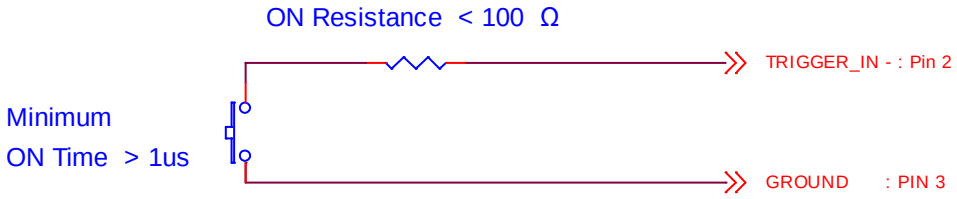


Fig. 7.14 Recommended Contact Trigger Input

7.4.2 Trigger Mode

Trigger modes can be divided into synchronous and asynchronous triggering (“Free-Run mode”) depending on the mode selected. The synchronous triggering modes are Standard, Double Exposure, Fast, and Overlap modes. The asynchronous triggering mode is Free-Run mode.

The Trigger Mode can be set to a synchronous mode through the CC1 port (serial port). For low latency (minimal delay), the external TRIGGER_IN port should be used as trigger input. The trigger polarity can be set Positive or Negative by serial commands or reversing the external TRIGGER_IN leads.

7.4.2.1 Free-Run Mode

Free-Run Mode will continiously be reading images based on the camera’s settings regardless if there is a trigger input.

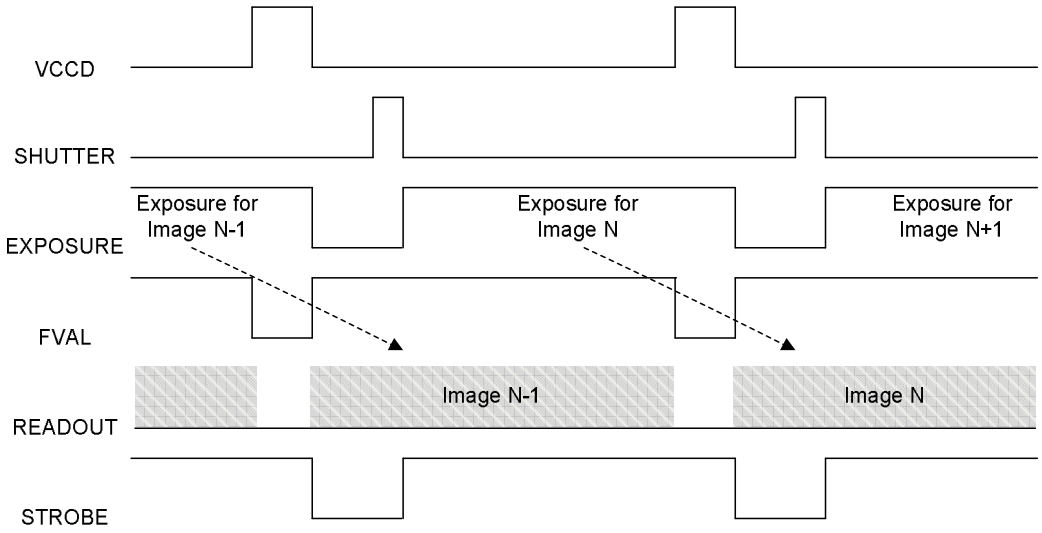


Fig. 7.15 Free-Run Mode

As shown in Fig. 7.15, the readout section overlaps with the exposure section of the next image. This is Free-Run Mode. At this time, camera operation slightly differs depending on length of Exposure Time and Readout time. If Exposure Time is shorter than Readout, Shutter signal occurs during readout, and when Readout finishes, Readout of the next image starts. (Fig. 7.16) In this case, frame speed is constant regardless of change in Exposure Time. But if Exposure Time is set longer than Readout time, the Shutter signal will occur at the start of the image Readout. Readout of the next image does not start until the Exposure Time is finished, even if Readout finishes. (Fig. 7.17) In this case, frame speed is reduced as the Exposure Time increases.

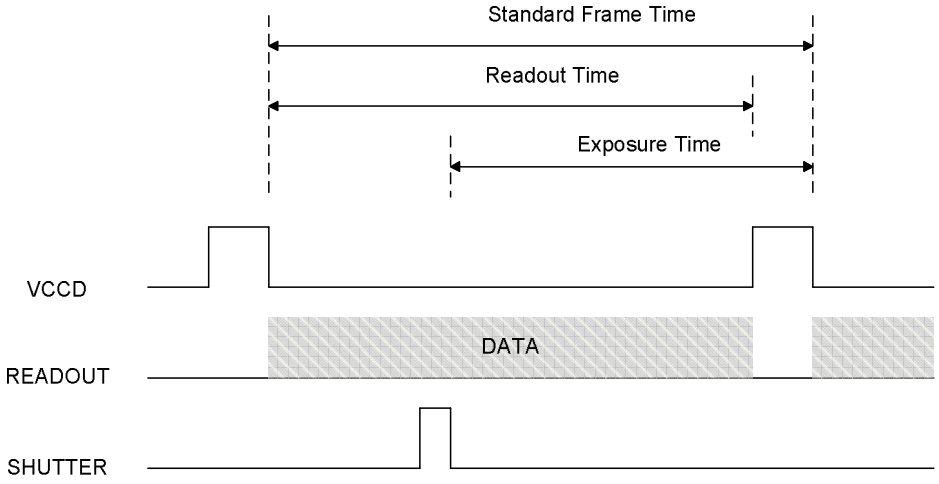


Fig. 7.16 If Exposure Time is Shorter than Readout Time

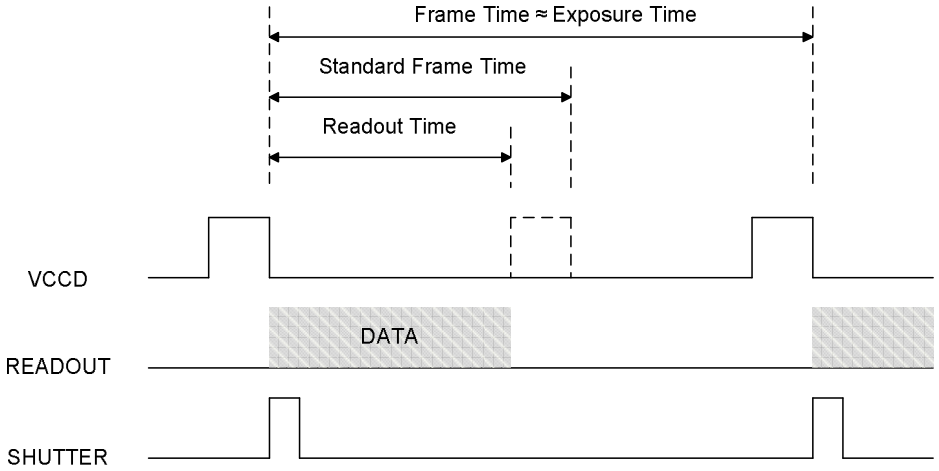


Fig. 7.17 If Exposure Time is Longer than Readout Time

7.4.2.2 Standard Mode

In Standard Mode, camera keeps standby status until trigger signal is entered, and when trigger input occurs, Readout start after Exposure process set earlier. After Readout is completed, camera operation slightly differs depending on Frame Number setting. Frame Number can be set as the value between 0~255. If it is set to 0, camera converts the operation mode to Free-Run mode, instead of returning to trigger standby status. If it is set to 1, it returns to trigger standby status. If it is set to the value of 2~255, it repeats Readout in Free-Run mode as many as the number less than 1 from the number set, and returns to trigger standby status again. “sfn” command is used to set Frame Number. (See 9.6.3 Frame Number)

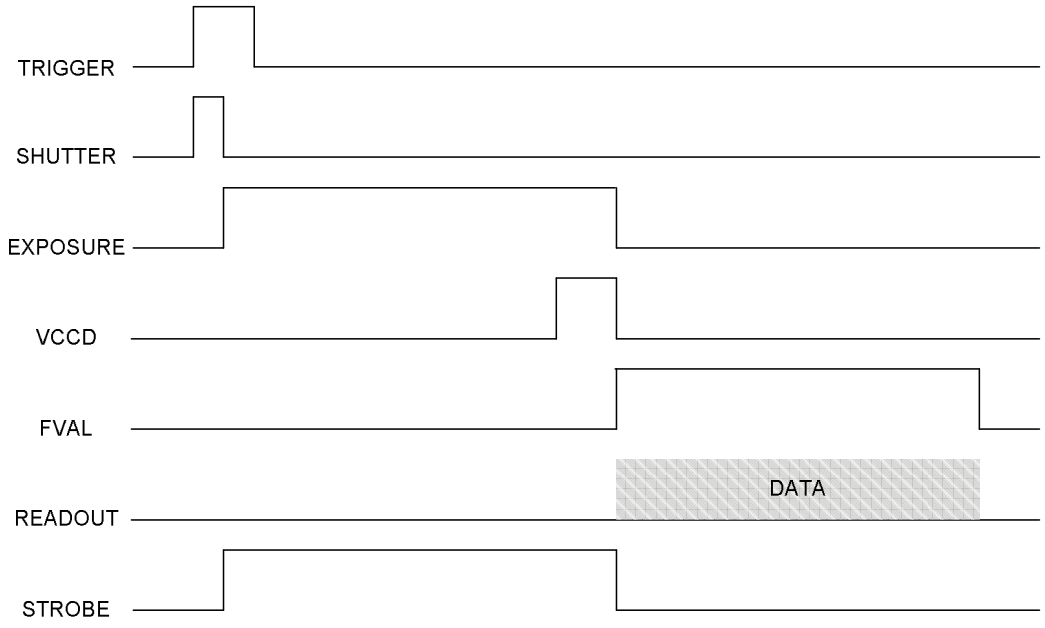


Fig. 7.18 Standard Trigger Mode

7.4.2.3 Double Exposure

In Double Exposure mode, 2 images are obtained with 1 trigger input. When trigger input is entered in this mode, the camera starts Readout after passing through exposure process according to exposure setting as in Standard mode. At this time, exposure of second image starts with Readout. When Readout is completed, the camera performs the second Readout.

In Double Exposure mode, it acts similarly as the case when Frame Number setting is 2 in Standard mode, but differs in that shutter signal occurs at least once. Therefore, when Frame Number setting of standard mode is 2, exposure time set in camera is applied in second image, while exposure time of second image in Double Exposure mode coincides with the Readout of 1st image. Since it does not generate shutter signal during Readout of the 1st image, the interval between completion of 1st exposure and starting of 2nd exposure is as short as several us ~ tens of us.

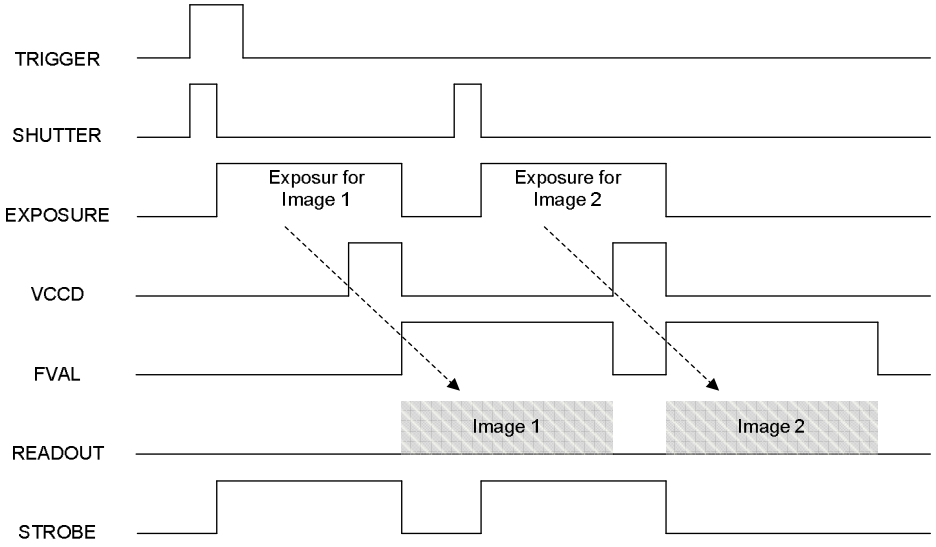


Fig. 7.19 Standard Trigger Mode (Frame Number 2)

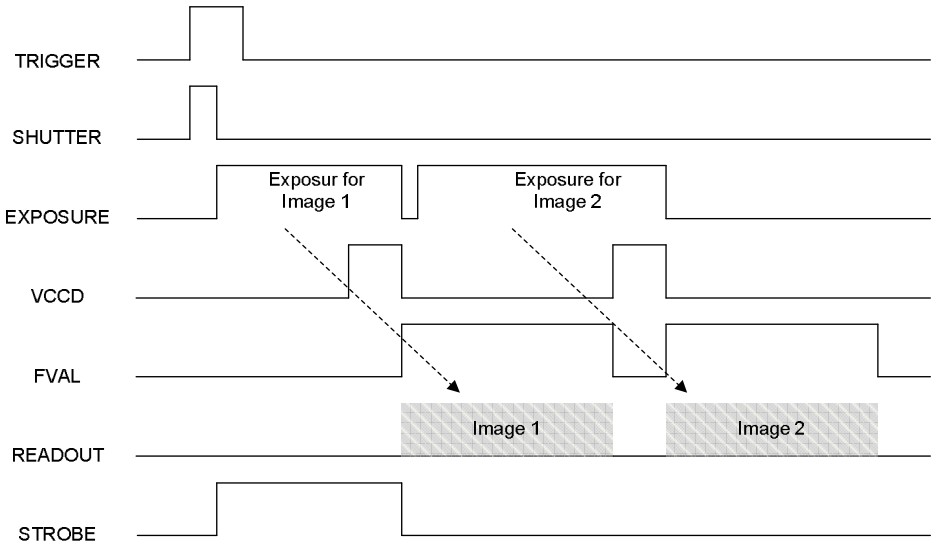


Fig. 7.20 Double Exposure Trigger Mode

7.4.2.4 Fast Mode

Fast Mode is used when interval of trigger input is faster and more continuous than in Standard Mode. Its difference from Standard Mode is that while Readout starts in exposure time as set earlier when trigger input occurs in Standard Mode, while Readout immediately starts after trigger input in Fast Mode. And Interval between triggers becomes the exposure time of image since it does not generate shutter signal during Readout.

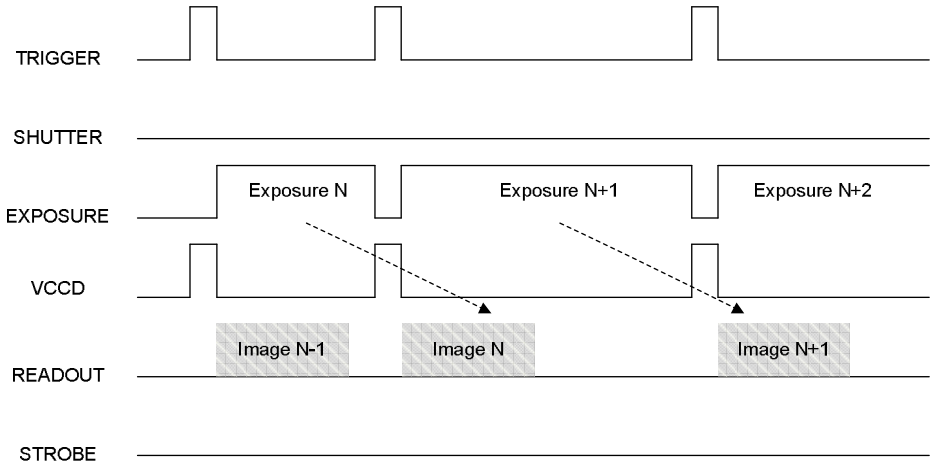


Fig. 7.21 Fast Trigger Mode

7.4.2.5 Overlap Mode

Camera keeps standby status until trigger signal is entered like in Standard Mode, and Readout starts after exposure process set earlier if trigger input occurs. When new trigger input occurs during Readout of First image, it keeps Readout and pass exposure process of new trigger input. Provided, however, that when trigger input occurs during Exposure since Exposure Time is longer than trigger interval, that trigger signal is ignored. To obtain the image as maximum frame for trigger input, Exposure Time should not be longer than Readout time, trigger time should not be shorter than Readout time. Readout time for each model is as follows:

	VH-310G-72	VH-310G-264	VH-2MG	VH-4MG	VH-11MG	VH-16MG
Readout Time	13.8ms	3.8ms	23.8ms	49.7ms	149.9ms	250ms

In addition, overlap mode operates ideally when trigger signal interval or exposure time is constantly kept.

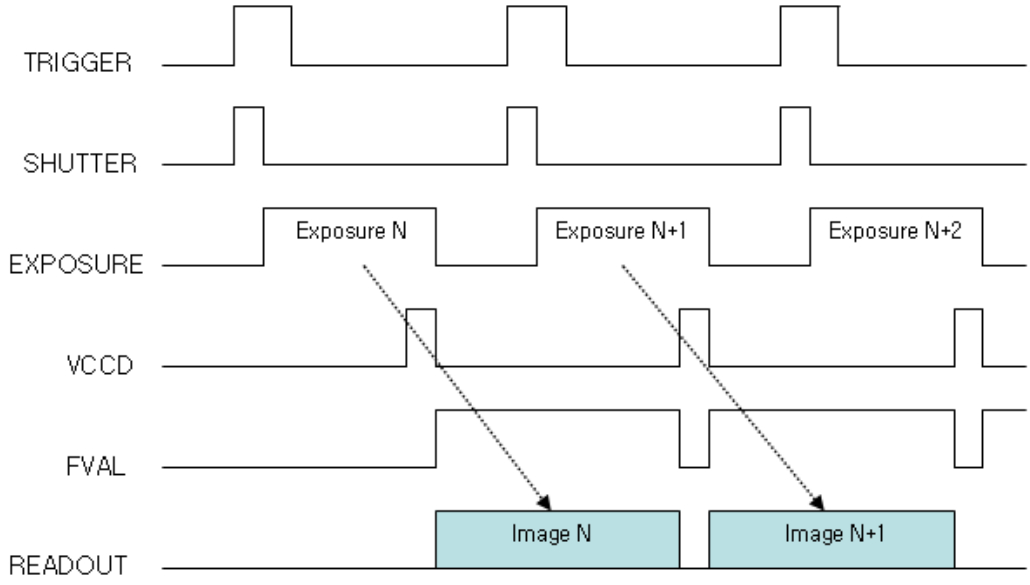


Fig. 7.22 Overlap Trigger Mode

7.4.3 Asynchronous Reset

If new trigger is entered in camera in trigger mode status during Readout due to generation of trigger input, it can be set to stop previous Readout process, to execute Exposure and Readout process for new trigger input, to ignore newly entered trigger and to continue previous Readout. This setting is called Async Reset, and the former is the case of activating Async Reset and the latter is the case of inactivating it. “sar” command is used for Async Reset setting.(See 9.6.6 Asynchronous Reset)

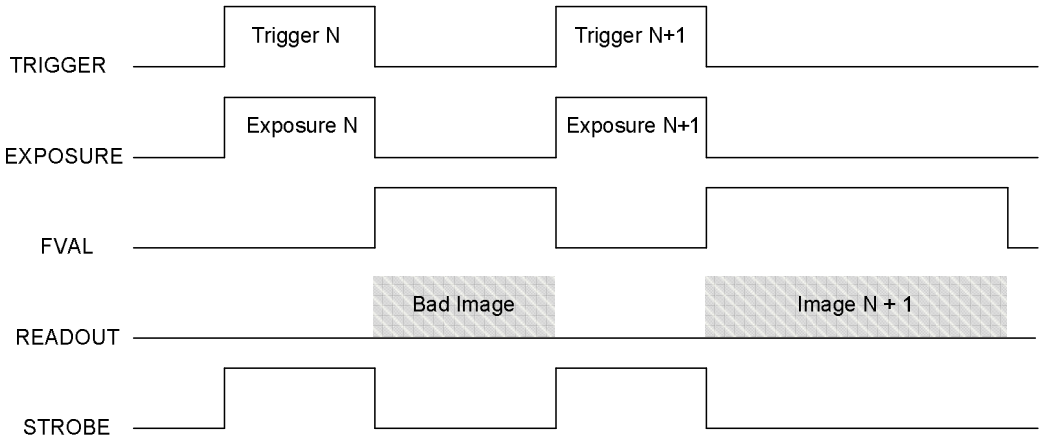


Fig. 7.23 Activate Async Reset

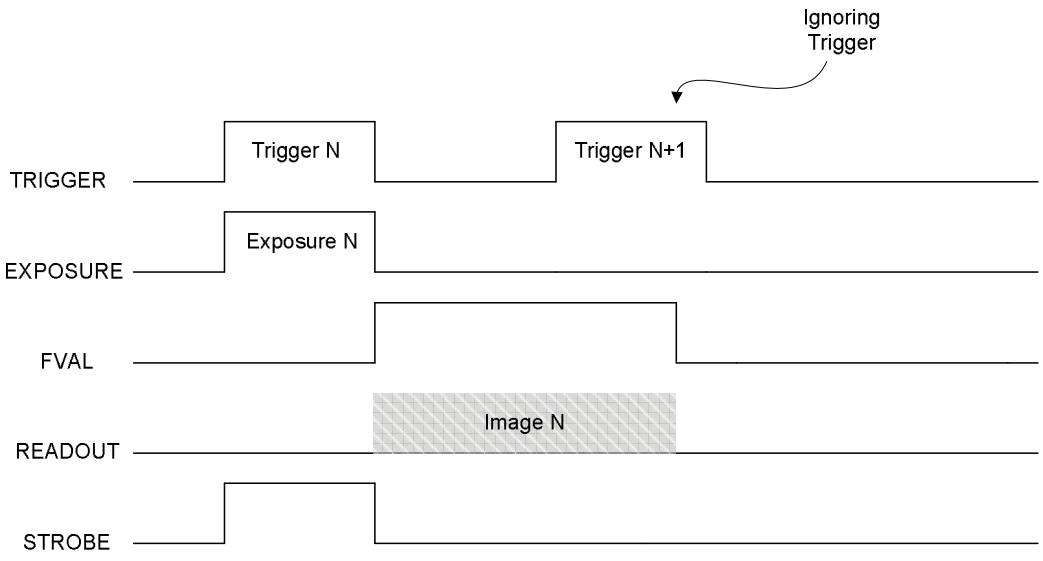


Fig. 7.24 Inactivate Async Reset

7.5 Channel Mode

When reading data from Horizontal Register of CCD, it can read in Single Channel or Dual Channel. In case of single channel output, all pixel values of Horizontal Register come through left Video Amplifier(Video L). In case of dual channel output, pixel values left to the center of Horizontal Register come through Video L, and pixel values to the right come through Video R. Since output to dual channel is carried out at the same time, the frame speed increases about 2 times than the case of single channel.

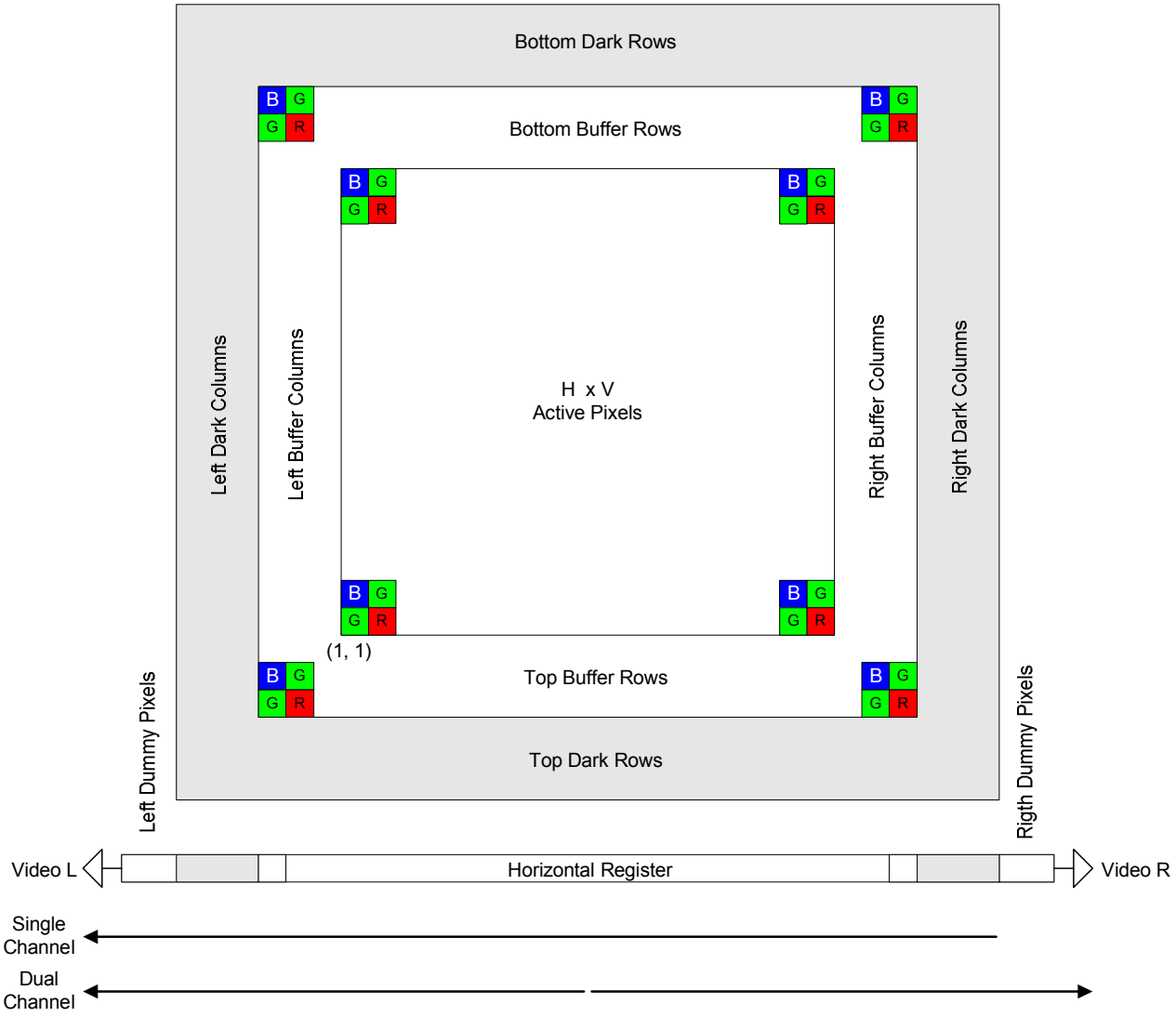


Fig. 7.25 Channel Mode

In case of single channel, image data through Video L is output to A channel through image processing (Fig. 7.26)
In case of dual channel, image data transmitted simultaneously through Video L and Video R is output in A, B Interleaved type through image processing and rearrangement(Fig. 7.27)

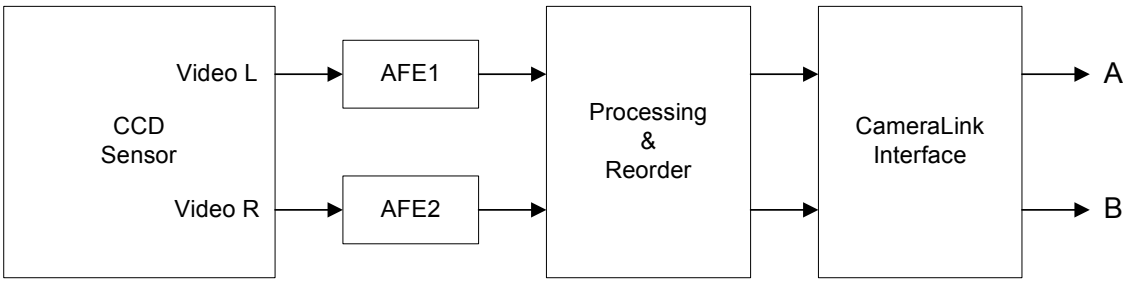


Fig. 7.26 Image Data Flow

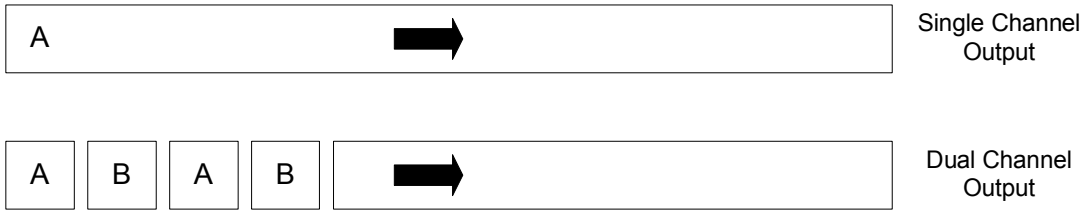


Fig. 7.27 Data Out

7.6 Gain and Offset

The camera has one Analog Signal Processor (or Analog Front End, abbreviated to AFE) for each channel. This AFE operates in 50MHz and consists of Correlated double Sampler (CDS), Variable Gain Amplifier (VGA), Black Level Clamp and 14-bit A/D converter. AFE has register for Gain and Offset application inside, and can change Gain and Offset value by entering proper value in the register. Gain can be set between 0 ~ 1023 (See 9.7 Analog Gain), and relation between set value and actual Gain (dB) is as follows:

Gain(dB) = (Setting value X 0.0358dB) + 5.75dB

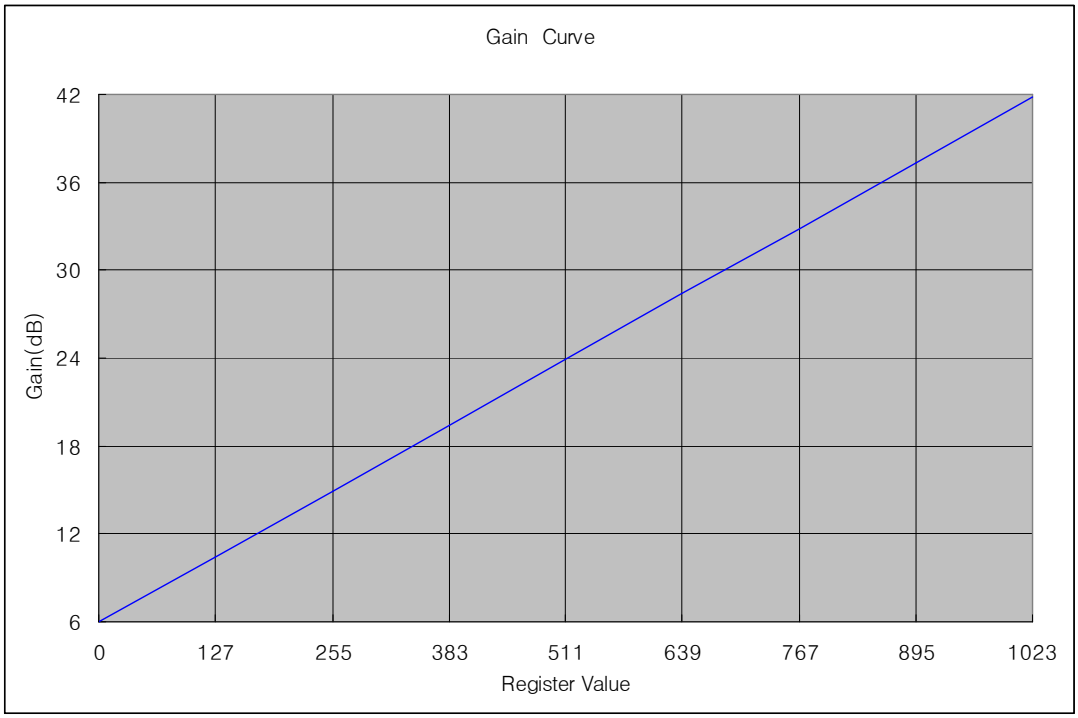


Fig. 7.28 Register Setting vs Gain

Offset can be set between 0 ~ 255 (LSB)(See 9.8 Analog Offset)

7.7 LUT

LUT (Lookup Table) converts original image value to certain level value. Since it is mapped one to one for each level value, 12-bit output can be connected to 12-bit input. LUT is in the form of table that has 4096 entries between 0~4095 and provides 2 non-volatile spaces for LUT data storage. User can select whether to apply LUT or not and the LUT to be applied using “sls” command.(See 9.12 LUT) See Appendix B for how to download LUT data in camera.

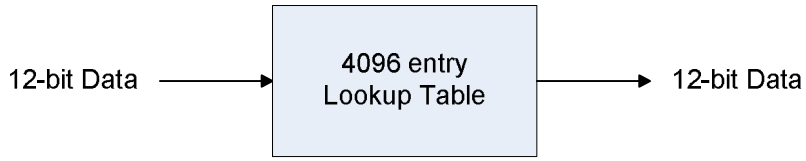


Fig. 7.29 LUT Block

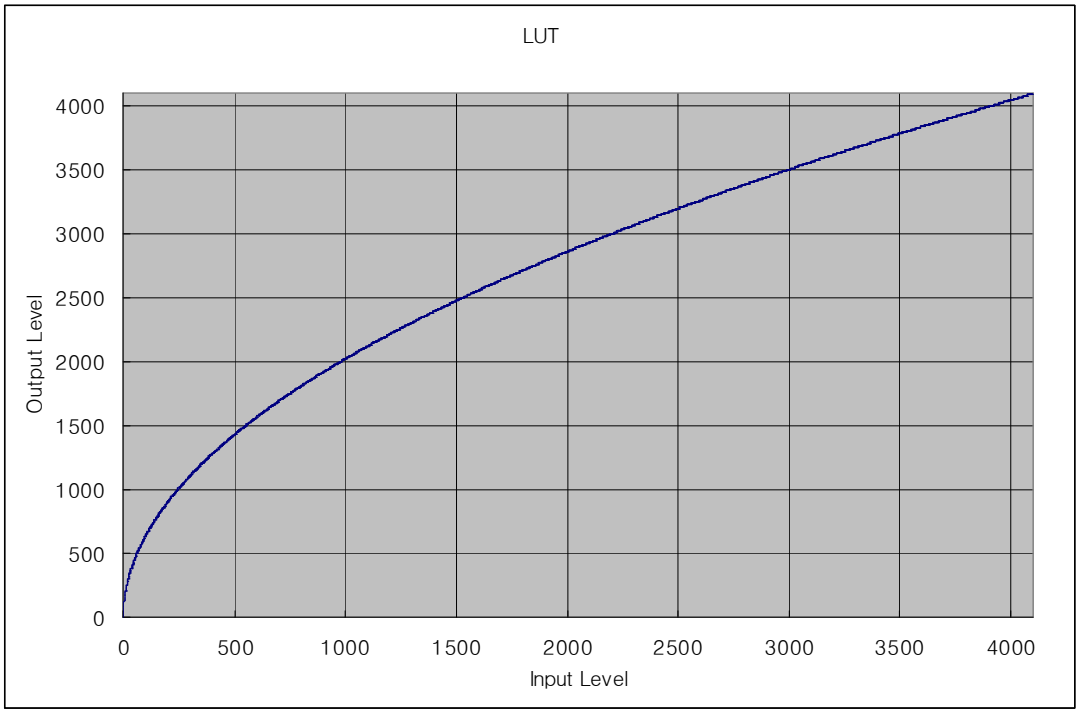


Fig. 7.30 LUT at Gamma 0.5

7.8 Defective Pixel Correction

There is Defective Pixel in CCD, which cannot properly react to the right. Correction is required since it may deteriorate the quality of output image. Defective Pixel information of CCD used for each camera is entered in the camera at the phase of forwarding from the factory. If the user wants to add Defective Pixel information, it is required to enter coordinate of new Defective Pixel in camera. See Appendix A for details. “sdc” command is used to set whether to use Defective Pixel Correction function (See 9.11 Defect Correction)

7.8.1 Correction Method

Correction value of Defective Pixel is calculated based on valid pixel value adjacent in the same line.

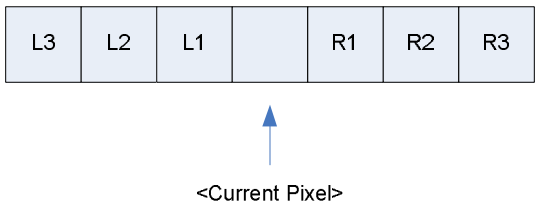


Fig. 7.31 Location of Defective Pixel to be Corrected

If there is Current Pixel, Defective Pixel to correct the value as shown in Fig. 7.31, correction value of this pixel is obtained as shown in the following Table 7.4 depending on whether surrounding pixel is Defective Pixel or not.

Adjacent Defective Pixel(s)	Correction value of Current Pixel
No	(L1 + R1) / 2
L1	R1
R1	L1
L1, R1	(L2 + R2) / 2
L1, R1, R2	L2
L2, L1, R1	R2
L2, L1, R1, R2	(L3 + R3) / 2
L2, L1, R1, R2, R3	L3
L3, L2, L1, R1, R2	R3

Table 7.4 Calculation of Defective Pixel Correction Value

7.9 Temperature Monitor

Sensor chip is embedded in camera to monitor the internal temperature. “gct” command is used to check the temperature of camera. (See 9.17 Temperature Monitoring)

7.10 Status LED

There is green LED to inform the operation status of camera on the back of camera. LED status and corresponding camera status are as follows:

- **Continuous ON status** – camera operates in Free-Run Mode.
- **Repeat ON for 0.5 seconds, OFF for 0.5 seconds** – camera operates in Trigger Mode.
- **Repeat ON for 1 second, OFF for 1 second** – Test Image is output.
- **Repeat ON for 0.25 second, OFF for 0.25 second** – operates in Trigger Mode and Test Image is output.

7.11 Data Format

Data can be processed in the unit of 12 bit internally, but can be selectively output in the unit of 8, 10, 12bit at output. When it is output in 8bit and 10bit unit, lower 4 bit and 2 bit are cut out from overall 12bits.

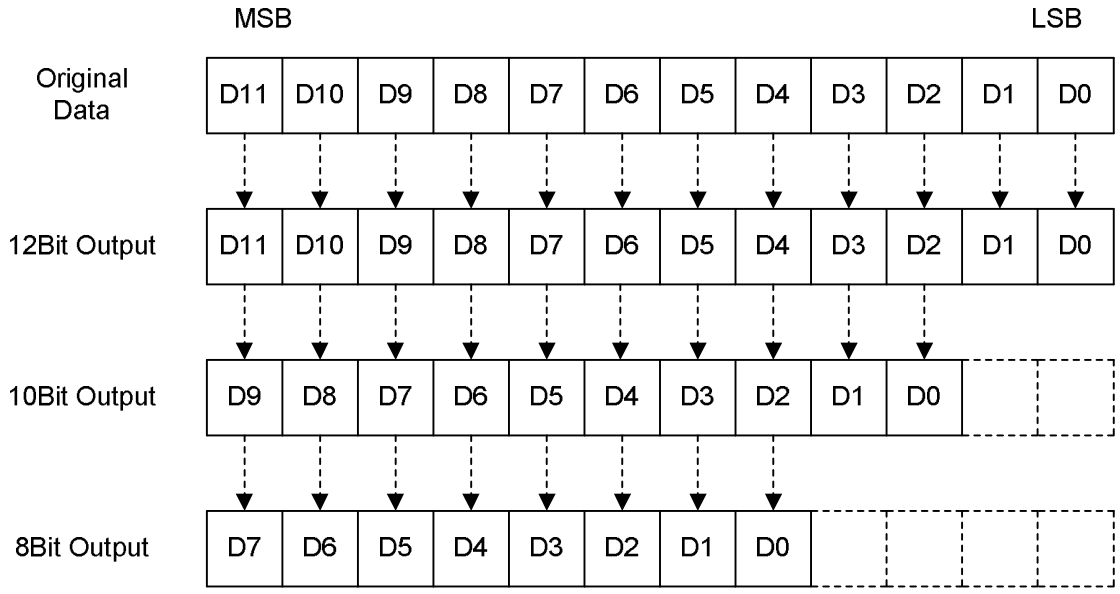

MSB
LSB
Original Data
D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0
12Bit Output
D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0
10Bit Output
D9 D8 D7 D6 D5 D4 D3 D2 D1 D0
8Bit Output
D7 D6 D5 D4 D3 D2 D1 D0

Fig. 7.32 Data Format

7.12 Test Pattern

To check normal operation of camera, it can be set to output test image created inside, instead of image data from CCD. There are 3 types of test image; image with different value in horizontal direction (Test Image 1), image with different value in diagonal direction (Test Image 2), and moving image with different value in diagonal direction (Test Image 3). Test image can be applied in all operation modes of camera and is set using “sti” command.(See 9.10 Test Image)

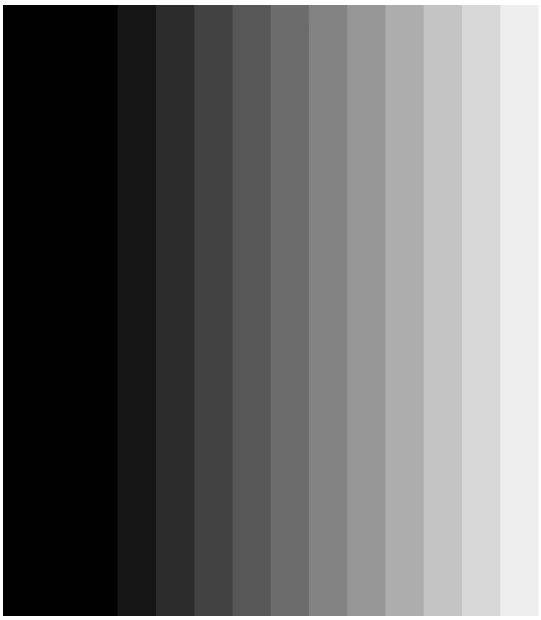


Fig. 7.33 Test Image 1

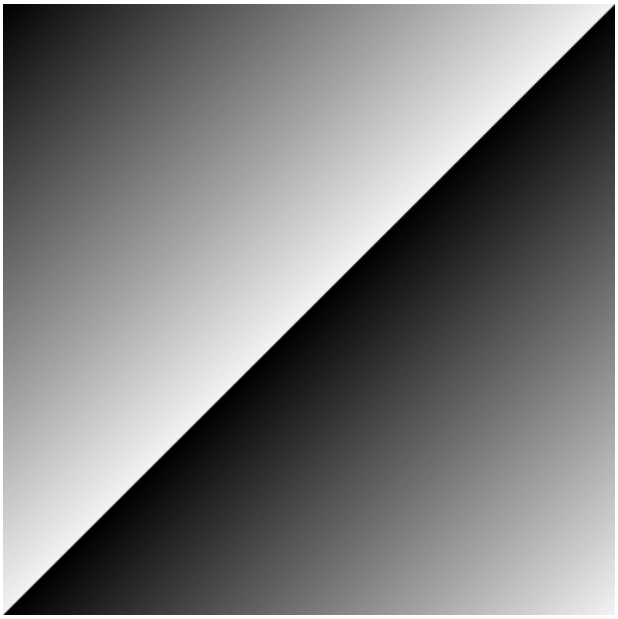


Fig. 7.34 Test Image 2

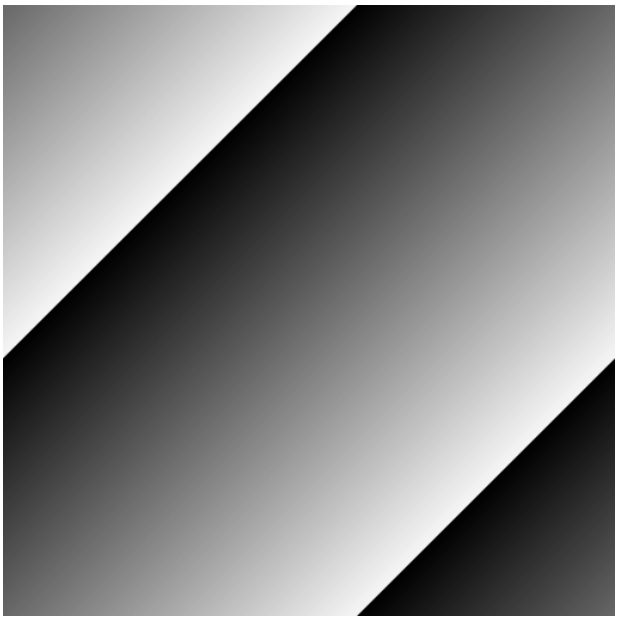


Fig. 7.35 Test Image 3

7.13 Horizontal Flip

Function to flip the image right and left based on the central axis of image. This function can be applied to all operation modes and “shf” command is used to set whether to use this function or not.

Fig. 7.36 Original Image

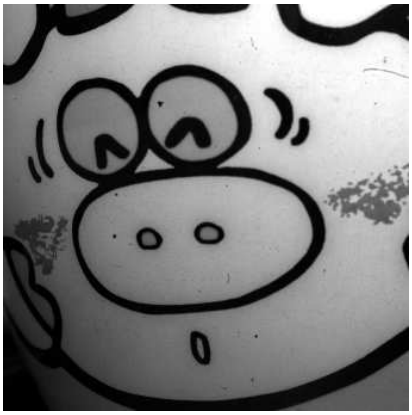


Fig. 7.37 Horizontally Flipped Image

7.14 Image Invert (Positive / Negative)

Function to invert the level value of output image. Level value inverted differs depending on output data format even if input value is same. This function can be applied in all operation modes of camera and “sii” command is used to set whether to use this function or not. (See 9.15 Image Invert)

Data Format	Original level value	Inverted level value
8	0	255
10	0	1023
12	0	4095

Table 7.5 Inverted level value by Data Format

Fig. 7.38 Original image (Positive)

Fig. 7.39 Inverted image (Negative)

7.15 Strobe

Strobe signal is used to measure the exposure time to synchrnoize the external light source with camera or to measure the exposure time applied to current camera. Pulse width of Strobe signal is from the generating point of Shutter signal to the starting point of Readout, which coincides with exposure time of camera.

7.15.1 Strobe Offset

Strobe Offset value indicates when Strobe signal is to be sent after Shutter signal. Value can be set in the unit of 1us using “sso” command. (See 9.16.1 Strobe Offset) Only pulse location moves without change in pulse width of Strobe signal.

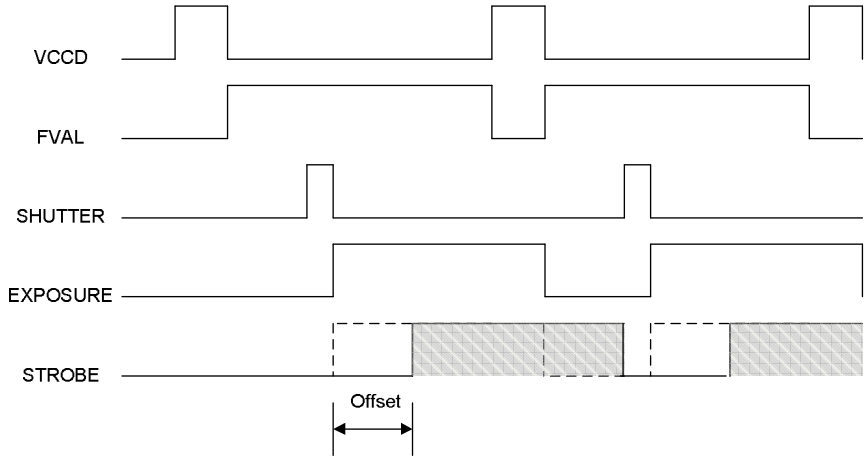


Fig. 7.40 Strobe signal in Free-Run

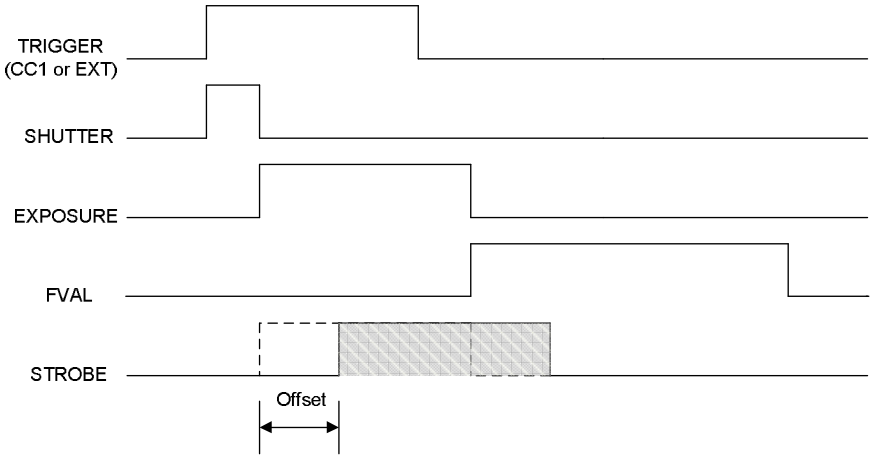


Fig. 7.41 Strobe signal in Trigger mode

7.15.2 Strobe Polarity

Polarity can be set for Strobe signal output. “ssp” command is used to set the polarity of Strobe signal.(See 9.16.2 Strobe Polarity)

7.15.3 Strobe Output

Strobe output is optically separated from inside camera and output through STROBE probe(STROBE+, STROBE-) of camera power connector.

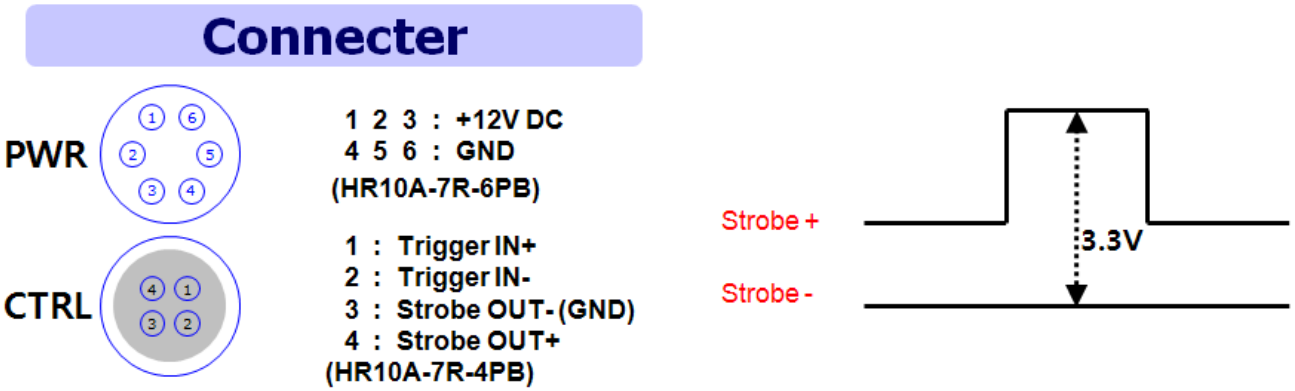


Fig. 7.42 Strobe Connection

7.16 Field Upgrade

Camera provides the function to upgrade Firmware와 FGPA logic through Camera Link or Gigabit Ethernet interface rather than disassembly in the field. See Appendix C for details on how to change

8. Camera Configuration

8.1 Setting Command

All settings of camera are carried out through serial interface of Camera Link. All commands for camera setting except commands (Firmware, LUT, Defect, etc.) requiring transmission of massive data are delivered in the form of ASCII command. All commands for camera setting start from user application and the camera returns the Response (“OK”, “Error” or information) for commands. With write command, the camera informs whether command is successfully executed through response. With read command, the camera returns error response or information.

- **UART Setting**
  - Baudrate : 19200 bps
  - Databit : 8 bit
  - Parity bit : none
  - Stop bit : 1
  - Flow control : none

- Command Format:

<command> <Parameter 1> <Parameter 2> <cr> command follows 0~2 parameters.

- Response:

- Execution of write command is successfully completed

OK <cr> <lf>

- Execution of read command is successfully completed

<Parameter 1> <cr> <lf>

- Execution of command is not successfully completed

Error : <error code> <cr> <lf>

- Type of Error Code

0x0064 : value of parameter is not valid

0x0065 : number of parameter does not agree

0x0066 : commands that does not exist

0x0067 : no execution right

8.2 Parameter Storage Spaces

Camera has 3 non-volatile storage space used for saving parameter, and 1 volatile work space applied to actual operation of camera. 3 storage spaces are Factory Space that contains the default at the time of forwarding from the factory; 2 user spaces (User Space 1, User Space 2) that save parameter values randomly set by the user. Both write and read are possible in user space, but only read is possible in Factory space.

Depending on Config Initialization value at the time of camera booting, setting value at one of 3 storage spaces is copied to work space, and the value in this space is used for camera setting. Since the value in the work space is valid only when the power is on, it is required to copy it to user space 1 or user space 2 using “sct” command in order to use this value again. (See 9.18.1.4 Save Config To)

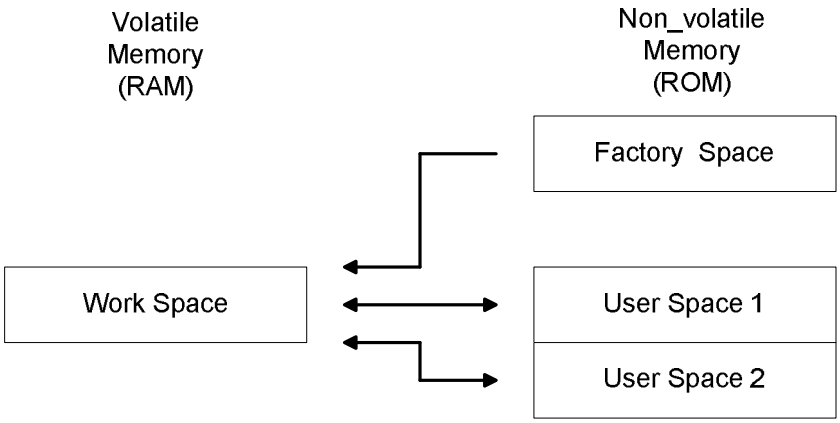


Fig. 8.1 Parameter Space

9. Command Set

Function	Command	Format	Page
Set Readout Mode	srm	<0|1|2>	52P
Get Readout Mode	grm		52P
Set Horizontal Area	sha	<h1> < h2>	53P
Get Horizontal Area	gha		53P
Set Vertical Area	sva	<v1> <v2>	53P
Get Vertical Area	gva		54P
Set Binning Factor	sbf	<2|4>	55P
Get Binning Factor	gbf		55P
Set Exposure Time	set	<t>	56P
Get Exposure Time	get		56P
Set Channel Mode	scm	<1|2>	57P
Get Channel Mode	gcm		57P
Set Trigger Mode	stm	<0|1|2|3|4>	58P
Get Trigger Mode	gtm		58P
Set Trigger Source	sts	<1|2>	59P
Get Trigger Source	gts		59P
Set Frame Number	sfn	<n>	59P
Get Frame Number	gfn		59P
Set Exposure Source	ses	<0|1>	60P
Get Exposure Source	ges		60P
Set Trigger Polarity	stp	<0|1>	61P
Get Trigger Polarity	gtp		61P
Set Asynchronous Reset	sar	<0|1>	61P
Get Asynchronous Reset	gar		61P
Set Analog Gain	sag	<0|1|2>	63P
Get Analog Gain	gag		63P
Set Analog Offset	sao	<0|1|2> <n>	64P
Get Analog Offset	gao		64P
Set Data bits	sdb	<8|10|12>	65P
Get Data bits	gdb		65P
Set Test Image	sti	<0|1|2|3>	66P
Get Test Image	gti		66P
Set Defect Correction	sdc	<0|1>	67P
Get Defect Correction	gdc		67P

Set LUT Select	sls	<0|1|2>	68P
Get LUT Select	gls		68P
Generate Flat Field Data	gfd		69P
Save Flat Field Data	sfd		69P
Load Flat Field Data	lfd		69P
Set Flat Field Iteration	sfi	<n>	69P
Get Flat Field Iteration	gfi		70P
Set Flat Field Correction	sfc	<0|1>	70P
Get Flat Field Correction	gfc		70P
Set Flat Field Offset	sfo	<m>	71P
Get Flat Field Offset	gfo		71P
Set Horizontal Flip	shf	<0|1>	72P
Get Horizontal Flip	ghf		72P
Set Image Invert	sii	<0|1>	73P
Get Image Invert	gii		73P
Set Strobe Offset	sso	<t>	74P
Get Strobe Offset	gso		74P
Set Strobe Polarity	ssp	<0|1>	74P
Get Strobe Polarity	gsp		74P
Get Camera Temperature	gct	<t>	76P
Set Config Initialization	sci	<0|1|2>	77P
Get Config Initialization	gci		77P
Load Config From	lcf	<0|1|2>	77P
Save Config From	sct	<0|1|2>	78P
Get Model Number	gmn		79P
Get MCU Version	gmv		79P
Get FPGA Version	gfv		79P

9.1 Readout Mode

9.1.1 Set Readout Mode

Form:

srm <0|1|2>

Parameter 1:

0 : Normal Mode.

1 : AOI(Area Of Interest) Mode.

2 : Binning(2 or 4) Mode.

Example:

srm 1 : set Readout mode to AOI Mode.

Description:

Set Readout mode value. In AOI Mode, horizontal and vertical space is set using “sha” and “sva” commands respectively (See 9.2 Area Of Interest) In Binning Mode, Binning Factor is set using “sbf” command. (See 9.3.1 Set Binning Factor)

9.1.2 Get Readout Mode

Form:

grm

Response:

<0|1|2>

Example:

[command] grm

[Response] 2 : Readout mode of current camera is set to Binning mode.

Description:

Read Readout mode value currently set

9.2 Area Of Interest

9.2.1 Horizontal Area

9.2.1.1 Set Horizontal Area

Form:

sha <h1> <h2>

Parameter 1:

h1 : starting point of horizontal direction

Parameter 2:

h2 : end point of horizontal direction

Example:

sha 500 1500 : set the horizontal direction scope of image between 500 ~ 1500.

Description:

Length of horizontal direction of image is h2 – h1 + 1. See Table 7.2 for the scope that can be set for each model.

9.2.1.2 Get Horizontal Area

Form:

gha

Response:

<h1> <h2>

Example:

[command] gha

[Response] 200 800 : horizontal AOI space set in camera is between 200 ~ 800.

Description:

Read horizontal scope of AOI currently set in camera.

9.2.2 Vertical Area

9.2.2.1 Set Vertical Area

Form:

sha <v1> <v2>

Parameter 1:

v1 : starting point of vertical direction

Parameter 2:

h2 : end point of vertical direction

Example:

sva 500 1500 : set the vertical direction scope of image between 500 ~ 1500.

Description:

Length of vertical direction displayed is v2 – v1 + 1. Table 7.2 for the scope that can be set for each model.

9.2.2.2 Get Vertical Area

Form:

gva

Response:

<v1> <v2>

Example:

[command] gva

[Response] 200 800 : vertical AOI space set in camera is between 200 ~ 800.

Description:

Read vertical scope of AOI space currently set in camera.

9.3 Binning Factor

9.3.1 Set Binning Factor

Form:

sbf <2|4>

Parameter 1 :

2 : 2 by 2 binning

4 : 4 by 4 binning

Example:

sbf 2 : set Binning Factor of camera to 2.

Description:

Set the Binning Factor when camera operates in Binning Mode.

9.3.2 Get Binning Factor

Form:

gbf

Response:

<2|4>

Example:

[command] gbf

[Response] 2 : Binning Factor of camera is set to 2.

Description:

Read Binning Factor currently set in camera

9.4 Exposure Time

9.4.1 Set Exposure Time

Form:

set <t>

Parameter 1:

t : can be set between 10us ~ 7s in the unit of 10us. For example, if t is 23173, the setting value of camera is 23170us. Setting value and the value actually applied slightly differ depending on Trigger mode of camera.

Example:

set 1052 : set Exposure Time to 1050us.

9.4.2 Get Exposure Time

Form:

get

Response:

<t> : read setting value of Exposure Time currently set in camera.

Example:

[command] get

[Response] 1000 : Exposure Time set in camera is 1000us.

9.5 Channel Mode

9.5.1 Set Channel Mode

Form:

scm <1|2>

Parameter 1:

1 : single channel

2 : dual channel

Example:

scm 2 : set to dual channel output.

Description:

Set whether to read in single channel or dual channel when reading image data from CCD. When dual channel is selected, frame speed is about 2 times of single channel.

9.5.2 Get Channel Mode

Form:

gcm

Response:

<1|2>

Example:

[command] gcm

[Response] 2 : set to dual channel output.

Description:

Read Channel Mode value currently set in camera.

9.6 Trigger

9.6.1 Trigger Mode

9.6.1.1 Set Trigger Mode

Form:

stm <0|1|2|3>

Parameter 1:

0 : Free-Run Mode

1 : Standard Mode

2 : Fast Mode

3 : Double Exposure Mode

4 : Overlap Mode

Example:

stm 1 : set Trigger Mode to Standard Mode.

Description:

Set detailed mode of Trigger Mode.

9.6.1.2 Get Trigger Mode

Form:

gtm

Response:

<0|1|2|3>

Example:

[command] gtm

[Response] 2 : Trigger Mode is set to Fast Mode.

Description:

Read the detailed model of Trigger Mode currently set in camera.

9.6.2 Trigger Source

9.6.2.1 Set Trigger Source

Form:

sts <1|2>

Parameter 1:

1 : Camera Link CC1

2 : External trigger

Example:

sts 1 : use CC1 of Camera Link as trigger input source.

Description:

Select the target to be used as trigger input.

Can use CC1 port of Camera Link connector or TRIGGER_IN port of power connector as input

9.6.2.2 Get Trigger Source

Form:

gts

Response:

<1|2>

Example:

[command] gts

[Response] 1 : CC1 of Camera Link is set as trigger input source.

Description:

Read Trigger Source value currently set in camera.

9.6.3 Frame Number

9.6.3.1 Set Frame Number

Form:

sfr <n>

Parameter 1:

n : can select 0 or 1~255 sheets.

Example:

sfr 5 : receive 5 sheets of image after trigger input.

Description:

In Standard Trigger mode, camera operation status after trigger input can be set. If Frame Number value is set to 0, the camera synchronizes to trigger input, obtains 1 sheet of image and then operates in Free-Run Mode after that. If Frame Number value is set to 1, the camera synchronizes to trigger input, obtains 1 sheet of image, but does not operate in Free-Run Mode after that but waits for next trigger input. Besides, value n is selected between 2~255, it obtains 1 sheet of image, obtains n-1 sheets of image in Free-Run mode status and returns to trigger standby status.

9.6.3.2 Get Frame Number

Form:

gfn

Response:

<n>

Example:

[command] gfn

[Response] 0 : synchronizes to trigger input, obtains 1 sheet of image and operates in Free-Run mode.

Description:

Return value between 0 ~ 255 depending on the value currently set.

9.6.4 Exposure Source

In Trigger Mode, you can select the factor determining exposure time.

9.6.4.1 Set Exposure Source

Form:

ses <0|1>

Parameter 1:

0 : exposure time is adjusted by the time value already entered.

1 : exposure time is adjusted by pulse width of trigger input.

Example:

ses 0 : expose as much as the value set with “ste” command when trigger is entered.

Description:

If Exposure Source is 0, set desired exposure time with “ste” command. If it is 1, pulse width of trigger input determines exposure time.

9.6.4.2 Get Exposure Source

Form:

ges

Response:

<0|1>

Example:

[command] ges

[Response] 0 : the factor determining exposure time in Trigger Mode is the programmed value.

Description:

Read Exposure Source in Trigger Mode, currently set in camera.

9.6.5 Trigger Polarity

9.6.5.1 Set Trigger Polarity

Form:

stp <0|1>

Parameter 1:

0 : Active Low

1 : Active High

Example:

stp 1 : set the polarity of trigger to Active High.

Description:

Set polarity of Trigger input.

9.6.5.2 Get Trigger Polarity

Form:

gtp

Response:

<0|1>

Example:

[command] gtp

[Response] 1 : polarity of trigger is set to Active High.

9.6.6 Asynchronous Reset

9.6.6.1 Set Async Reset

Form:

sar <0|1>

Parameter 1:

0 : inactivate Async Reset.

1 :activate Async Reset.

Example:

sar 1 : activate Async Reset.

Description: set On/Off of Asynchronous Reset function.

9.6.6.2 Get Async Reset

Form:

gar

Response:

<0|1>

Example:

[command] gar

[Response] 1 : Async Reset is activated.

9.7 Analog Gain

9.7.1 Set Analog Gain

Form:

sag <0|1|2> <n>

Parameter 1:

0 : apply input value to dual channels.

1 : apply input value to channel 1.

2 : apply input value to channel 2.

Parameter 2:

n : gain value. 0~1023

Example:

sag 0 100 : set gain register of both AFE to 100.

Description:

value 0 of n corresponds to 6dB, 1023 to 40dB. Gain increases by 0.035dB each whenever it increases by 1.

9.7.2 Get Analog Gain

Form:

gag <0|1|2>

Parameter 1:

0 : read all values set in dual channels.

1 : read value set in channel 1.

2 : read value set in channel 2.

Response:

<n1> <n2>

Example:

[command] gag 1

[Response] 100 : Gain register value of channel1 AFE is set to 100.

Description:

If Parameter 1 is 0, it returns 2 values of n1 and n2, which mean gain value of channel 1 and channel 2, respectively. If Parameter 1 is 1 or 2, it returns only one value and means gain value of channel indicated by Parameter 1.

9.8 Analog Offset

9.8.1 Set Analog Offset

Form:

sao <0|1|2> <n>

Parameter 1:

0 : apply input value to dual channels.

1 : apply input value to channel 1.

2 : apply input value to channel 2.

Parameter 2:

n : offset value. 0~255

Example:

sao 0 100 : set Offset register of both AFEs to 100.

9.8.2 Get Analog Offset

Form:

gao <0|1|2>

Parameter 1:

0 : read all values set in dual channels.

1 : read value set in channel 1.

2 : read value set in channel 2.

Response:

<n1> <n2>

Example:

[command] gao 1

[Response] 100 : Offset registers value of channel1 AFE is set to 100.

Description:

If Parameter 1 is 0, it returns 2 values of n1 and n2, which mean offset value of channel 1 and channel 2, respectively. If Parameter 1 is 1 or 2, it returns only one value and means offset value of channel indicated by Parameter 1.

9.9 Data Bits

9.9.1 Set Data Bits

Form:

sdb <8|10|12>

Parameter 1:

8 : 8-bit output.

10 : 10-bit output.

12 : 12-bit output.

Example:

sdb 8 : set output data width of camera to 8-bit.

Description:

Determine output data width of camera.

9.9.2 Get Data

Form:

gdb

Response:

<8|10|12>

Example:

[command] gdb

[Response] 10 : output data width of camera is set to 10-bit.

Description:

Read output data width of camera currently set.

9.10 Test Image

9.10.1 Set Test Image

Form:

sti <0|1|2|3>

Parameter 1:

0 : Test Image Off.

1 : Test Image 1 output.

2 : Test Image 2 output.

3 : Test Image 3 output.

Example:

sti 2 : output Test Image 2 instead of image obtained from CCD.

Description:

Set whether to send out Test Image from CCD. There are 3 Test Images available for selection. If you select 0, original CCD image is output. If you select value between 1~3, Test Image corresponding to each number is output.

9.10.2 Get Test Image

Form:

gti

Response:

<0|1|2|3>

Example:

[command] gti

[Response] 3 : camera sends current Test Image 3 to output.

Description:

Read Test Image setting of current camera

9.11 Defect Correction

9.11.1 Set Defect Correction

Form:

sdc <0|1>

0 : Inactivate Defect Correction function.

1 : Activate Defect Correction function.

Example:

sdc 1 : Activate Defect Correction function.

Description:

Activate or inactivate Defect Correction function. Defect map should be saved in camera in advance if you want to use Defect Correction function. Defect Correction function is not applied in Binning Mode.

9.11.2 Get Defect Correction

Form:

gdc

Response:

<0|1>

Example:

[command] gdc

[Response] 1 : Defect Correction function of camera is activated.

Description:

Read whether Defect Correction is activated or not.

9.12 LUT (Look-Up Table)

9.12.1 Set LUT Select

Form:

sls <0|1|2>

Parameter 1:

0 : LUT is not applied.

1 : LUT 1 is applied.

2 : LUT 2 is applied.

Example:

sls 1 : LUT 1 is applied.

Description:

Set Look-UP Table of camera. LUT of the number should be saved in camera in advance in order to use LUT function.

9.12.2 Get LUT Select

Form:

gls

Response:

<0|1|2>

Example:

[command] gls

[Response] 0 : LUT is inactivated.

Description:

Read LUT setting of camera.

9.13 Flat Field Correction

9.13.1 Flat Field Data

9.13.1.1 Generate Flat Field Data

Form:

gfd

Description:

Operate Flat Field Generator. Since several images are required internally to create Flat Field data, it takes about several seconds before “OK” Response.

9.13.1.2 Save Flat Field Data

Form:

sfd

Description:

Flat Field data created with ”gfd” command is saved in frame buffer, which is volatile memory, so that data disappears if the power of camera is turned off. Data should be saved in FLASH, the non-volatile memory space, if you want to use the data generated again. At this time, “sfd” is the command used for this.

9.13.1.3 Load Flat Field Data

Form:

lfd

Description:

It is the command to load Flat Field data saved in FLASH in advance, into frame buffer to apply Flat Field Correction function.

9.13.2 Flat Field Iteration

9.13.2.1 Set Flat Field Iteration

Form:

sfi <n>

Parameter 1:

n : 0 ~ 4. 2^n sheets of image are used.

Example:

sfi 3 : 8 sheets of image are used for creating Flat Field data.

Description:

Can set how many sheets of image will be used on average to create the data for creating Flat Field Data. The smaller the pieces, it takes less to create data, but the accuracy of data may decline.

9.13.2.2 Get Flat Field Iteration

Form:

gfi

Response:

<n> : 0 ~ 4

Example:

[command] gfi

[Response] 2 : set to use 4 sheets of image when creating Flat Field data.

Description:

Load how many pages of image are set to use in creating Flat Field data.

9.13.3 Flat Field Correction

9.13.3.1 Set Flat Field Correction

Form:

sfc <0|1>

Parameter 1:

0 : Turn Flat Field Correction functions OFF.

1 : Turn Flat Field Correction functions ON.

Example:

sfc 1 : Turn Flat Field Correction functions of camera ON.

Description:

Set whether to use Flat Field Correction function.

9.13.3.2 Get Flat Field Correction

Form:

gfc

Response:

<0|1>

Example:

[command] gfc

[Response] 1 : Flat Field Correction function of camera is activated.

9.13.4 Flat Field Offset

9.13.4.1 Set Flat Field Offset

Form:

sfo m

Parameter 1:

m : offset value of image corrected

Example:

sfo 1000 : set offset value of Flat Field Correction to 1000.

Description:

It is the command to set offset value of image after Flat Field Correction. Since offset value is based on single channel, Normal Mode, offset value of actual image differs if camera setting is changed.

9.13.4.2 Get Flat Field Offset

Form:

gfo

Response

m

Example:

[command] gfo

[Response] 1000 : Flat field Offset value is set to 1000.

9.14 Horizontal Flip

Function to flip image left and right.

9.14.1 Set Horizontal Flip

Form:

shf <0|1>

Parameter 1:

0 : inactivate Horizontal Flip function.

1 : activate Horizontal Flip function.

Example:

shf 1 : activate Horizontal Flip function.

Description:

Set whether to activate Horizontal Flip.

9.14.2 Get Horizontal Flip

Form:

ghf

Response:

<0|1>

Example:

[command] ghf

[Response] 1 : Horizontal Flip function is activated.

Description:

Get Horizontal Flip setting.

9.15 Image Invert

9.15.1 Set Image Invert

Form:

sii <0|1>

Parameter 1:

0 : inactivate image Inverted function

1 : activate image Inverted function

Example:

sii 1 : activate Image Invert function

Description:

Set whether to activate image Inverted function

9.15.2 Get Image Invert

Form:

gii

Response:

<0|1>

Example:

[command] gii

[Response] 1 : Image Invert function is activated.

Description:

Get image Inverted function setting.

9.16 Strobe

9.16.1 Strobe Offset

9.16.1.1 Set Strobe Offset

Form:

sso <t>

Parameter 1:

t : 0 ~ 65535us. Can be set in the unit of 1us.

Example:

sso 123 : can set Strobe Offset value to 123us.

9.16.1.2 Get Strobe Offset

Form:

gso

Response:

<t>

Example:

[command] gso

[Response] 120 : Strobe Offset value is set to 120us.

Description:

Load Strobe Offset value currently set in camera.

9.16.2 Strobe Polarity

9.16.2.1 Set Strobe Polarity

Form:

ssp <0|1>

Parameter 1:

0 : set to Active-Low.

1 : set to Active-High.

Description:

Set polarity of Strobe signal output.

9.16.2.2 Get Strobe Polarity

Form:

gsp

Response:

<0|1>

Example:

[command] gsp

[Response] 1 : Strobe signal output is set to Active-High.

Description:

Get polarity of Strobe signal output set in camera.

9.17 Temperature Monitoring

9.17.1 Get Camera Temperature

Form:

gct

Response:

<t>

Example:

[command] gct

[Response] 45.35 : current temperature of camera is 45.35 ℃.

Description:

Get current temperature of camera. Unit is centigrade(℃) and is expressed to the 2nd place of decimal point.

9.18 Configuration

9.18.1 Config Initialization

9.18.1.1 Set Config Initialization

Form:

sci <0|1|2>

Parameter 1:

0 : load setting value saved in factory space at the time of booting

1 : load setting value saved in user space 1 at the time of booting

2 : load setting value saved in user space 2 at the time of booting

Example:

sci 2 : load the setting value of User Space 2 into Work Space at the time of camera booting.

Description:

Select to apply parameter value saved in which area when the power of camera is turned on. At factory, it is set to apply setting value in the factory space.

9.18.1.2 Get Config Initialization

Form:

gci

Response:

<0|1|2>

Example:

[command] gci

[Response] 2 : set to apply setting value of user space 2 at the time of camera booting.

Description:

Get Config Initialization variable value, indicating the setting value in which area will be used when camera is turned on.

9.18.1.3 Load Config From

Form:

lcf <0|1|2>

Parameter 1:

0 : reset the camera with setting value saved in the factory space.

1 : reset the camera with setting value saved in the user space 1.

2 : reset the camera with setting value saved in the user space 2.

Example:

lcf 1 : reset the camera with setting value saved in user space 1.

lcf

Description:

This command is used to reset the camera with the setting value saved in some space in operation without turning off and on the camera. “sci” command applies setting value at the time of next booting, but “lcf” applies setting value immediately.

9.18.1.4 Save Config To

Form:

sct <0|1|2>

Parameter 1:

0 : save setting value currently used in the factory space. User access to this space is limited.

1 : save setting value currently saved in user space 1.

2 : save setting value currently saved in user space 2.

Example:

sct 1 : save setting value(setting value that exists in Work Space) currently used in user space 1.

Description:

This command is to save the setting value set in Work Space in Parameter storage area to load again later. User can save in user space 1 or user space 2 only.

9.19 Camera Information

9.19.1 Get Model Number

Form:

gmn

Description:

Get information of camera model.

9.19.2 Get MCU Version

Form:

gmv

Description:

Get version information of micro controller firmware.

9.19.3 Get FPGA Version

Form:

gfv

Description:

Get version information of FPGA logic.

10. VH Configurator

VH Configurator is the sample application supplied to control VH camera. VH Configurator uses commands explained in earlier chapters and provides GUI(Graphic User Interface) for easier control of camera by users.

10.1 Configurator GUI

10.1.1 VH Camera Scan

Camera Scan window appears as shown in Fig. 10.1 if you execute the program while the power of camera is turnedon. At this time, the program checks DLL provided by camera link and serial port of computer to scan whether camera is connected, and displays the name of model on the display. If the camera is not properly displayed on the screen, check the power of camera and cable connection again and then press Refresh button. Double-click the model name displayed on the screen to execute Configurator and to display the current setting value of camera connected.

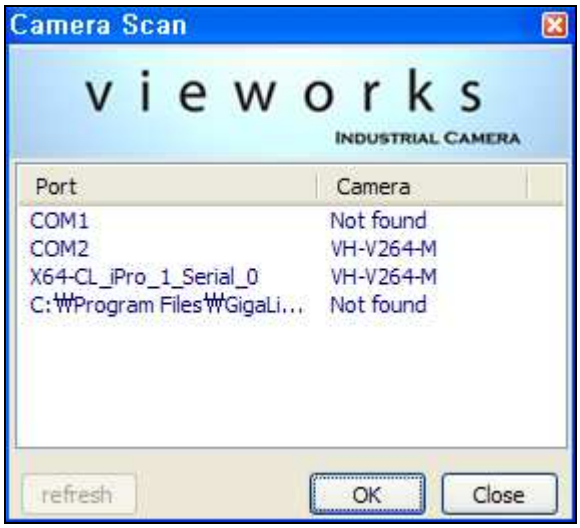
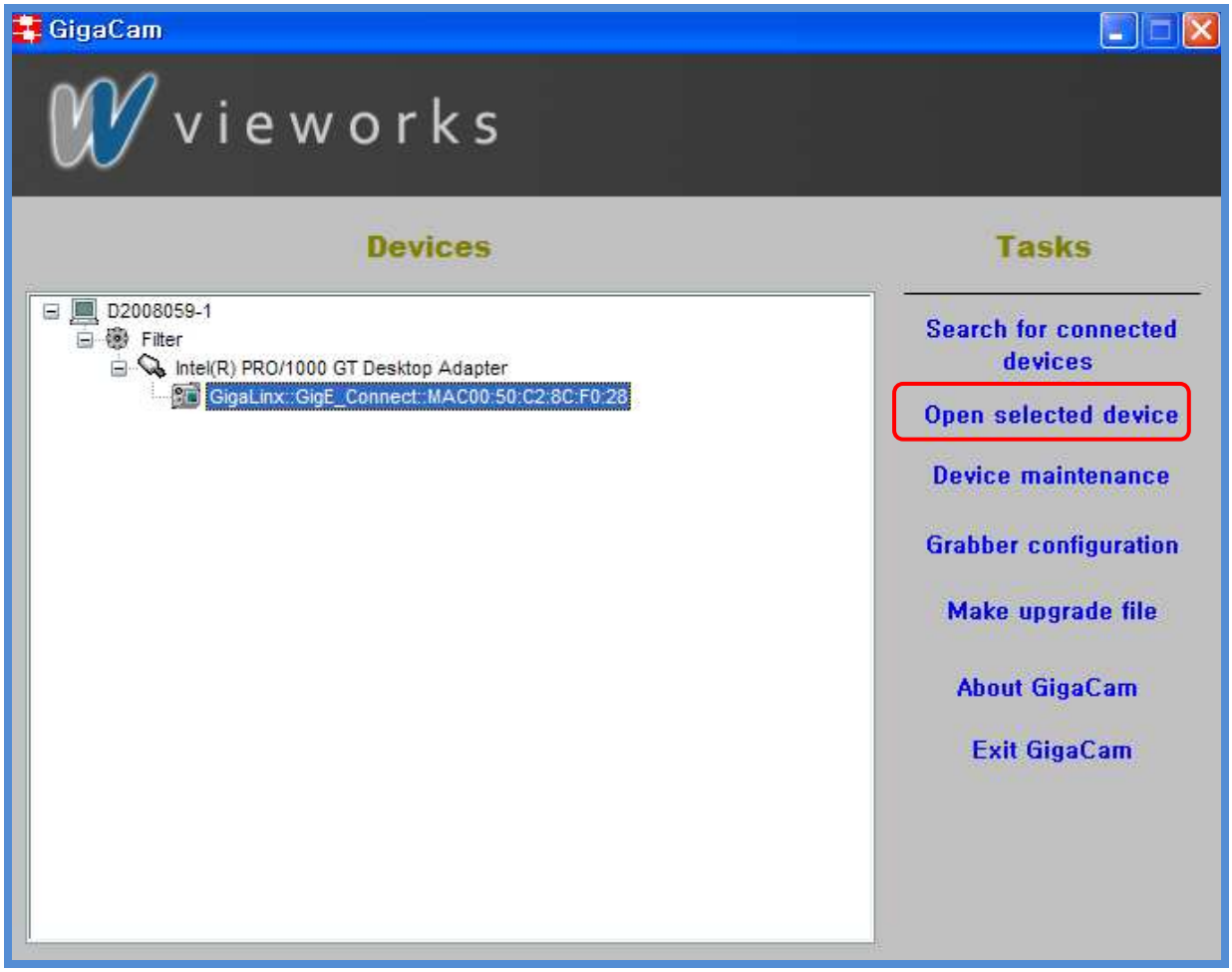
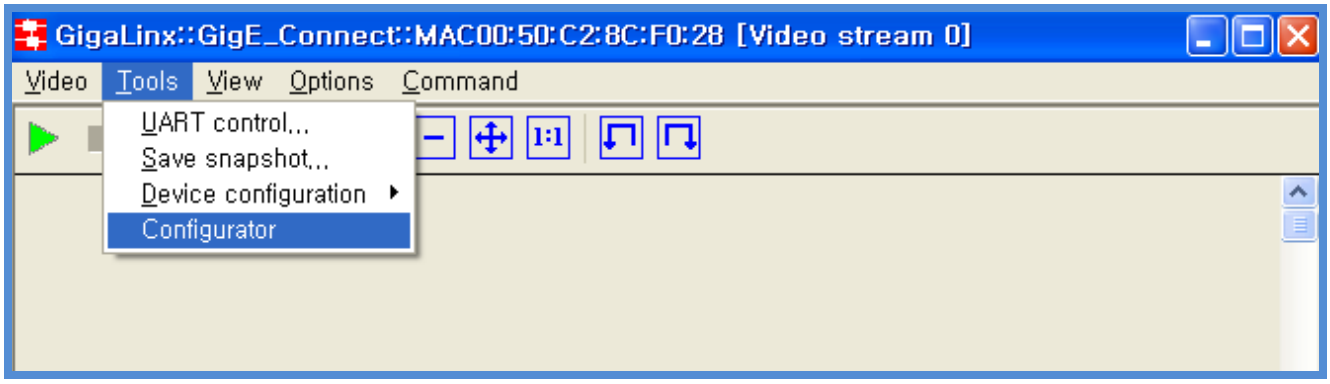


Fig. 10.2 VH Configurator Loading Window

10.1.2 VH GigE Camera Scan

Execute GigaCam program while camera is turned on, and execute Open selected device => Tools => Configurator to display Camera Scan window as shown in Fig. 10.2. At this time, the program checks serial port of computer to scan the camera connection, and displays the name of model on the display if there is a camera connected. If the camera is not properly displayed on the screen, check the power of camera and cable connection again, and press Refresh button. Double click the name of model displayed on the screen, to execute Configurator and to display current setting value of camera connected.


GigaCam
vieworks
Devices
Tasks
D2008059-1
Filter
Intel(R) PRO/1000 GT Desktop Adapter
GigaLinx::GigE_Connect::MAC00:50:C2:8C:F0:28
Search for connected devices
Open selected device
Device maintenance
Grabber configuration
Make upgrade file
About GigaCam
Exit GigaCam


GigaLinx::GigE_Connect::MAC00:50:C2:8C:F0:28 [Video stream 0]
Video
Tools
View
Options
Command
UART control...
Save snapshot...
Device configuration
Configurator
1:1

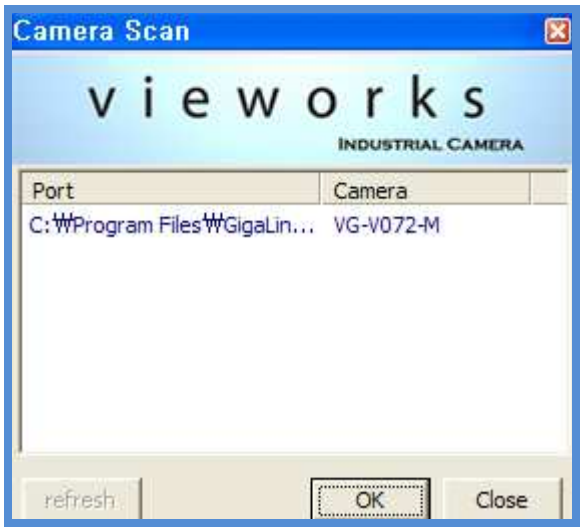


Fig. 10.3 Configurator Loading Window

10.1.3 Menu

10.1.3.1 File

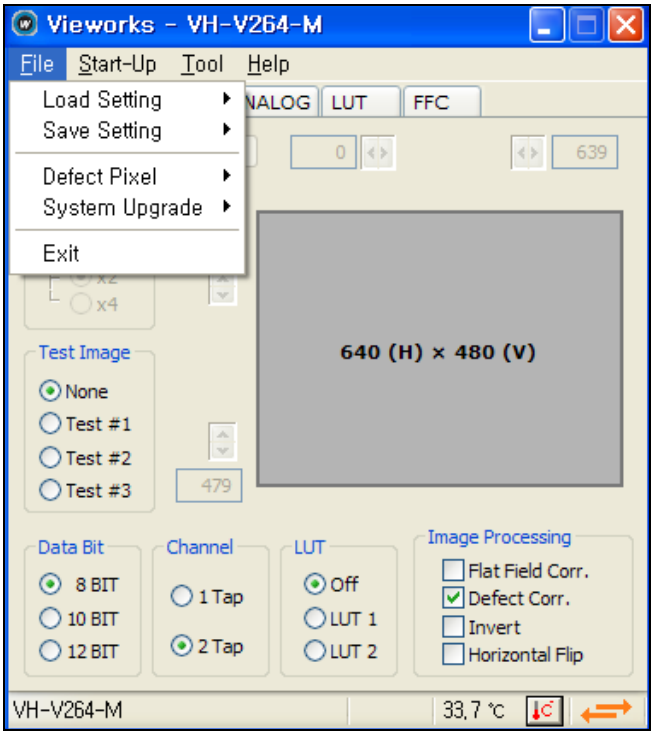


Fig. 10.4 File Menu

Load Setting : load the setting value of camera. Load from the setting value storage space(Factory, User1, User2) inside the camera or file in the user computer.

Save Setting : save setting value of camera. Save in setting value storage space(User1, User2) inside the camera or file in the computer.

Defect Pixel : download Defect information to camera (Download to Camera) or upload the Defect information saved in camera to user computer (Upload to PC).

System Upgrade : Upgrade MCU program or FPGA logic.

Exit : Exit the program.

10.1.3.2 Start-Up

Menu to select the area to load setting value from when camera is turned on.(See 9.18.1 Config Initialization)

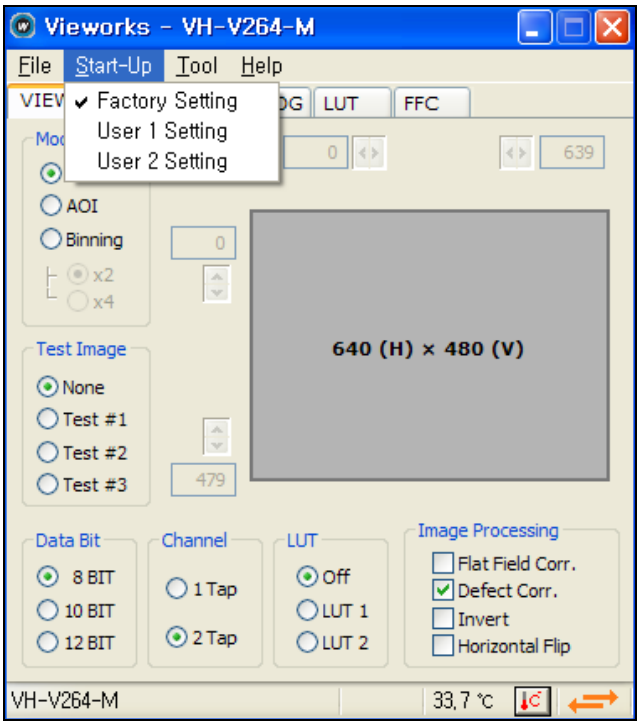


Fig. 0.1 Start-Up Menu

Factory Setting : load the setting value from Factory space when camera is turned on.

User1 Setting : load the setting value from User1 space when camera is turned on.

User2 Setting : load the setting value from User2 space when camera is turned on.

10.1.3.3 Tool

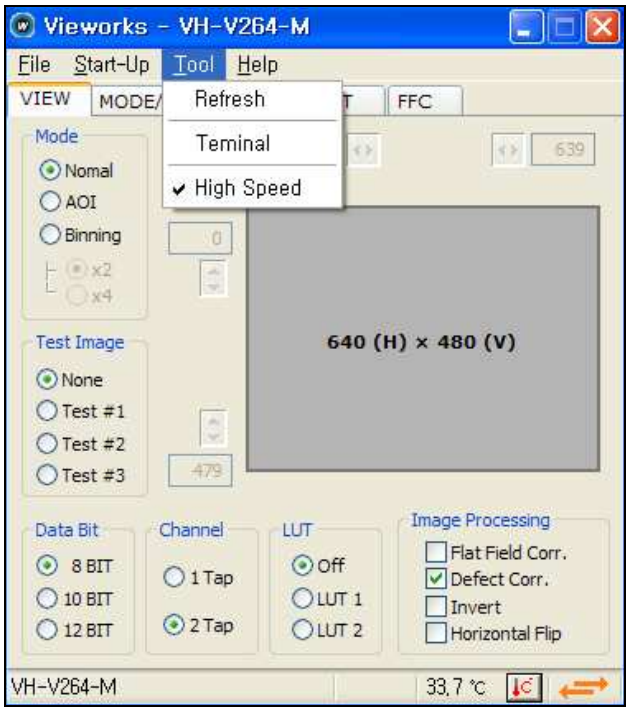


Fig. 0.1 Tool Menu

Refresh : load and display the current setting value of camera on the program.

Terminal : display user command under GUI in terminal. Click to display terminal window on the bottom of program. Click again to hide Terminal window.

High Speed : operate in OverClock mode (50Mhz) when checked. If not checked, operates in Normal mode (40Mhz). (Except VH-V72model)

10.1.3.4 Help

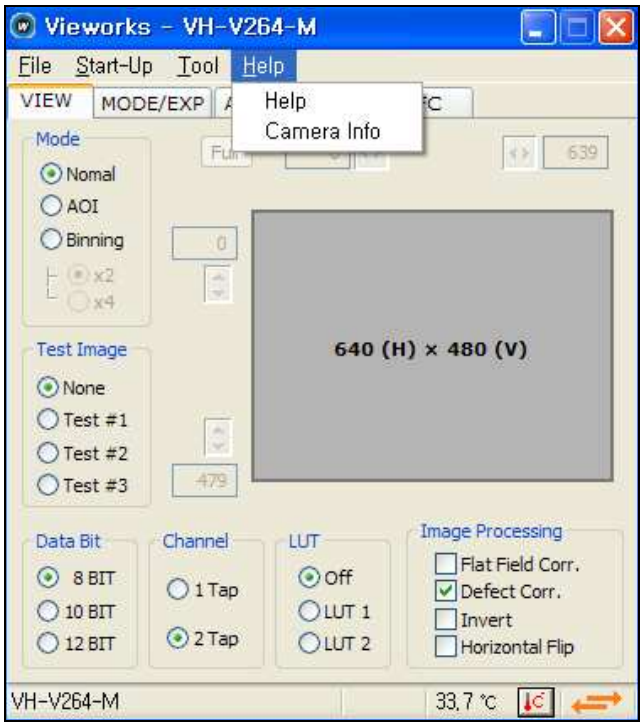


Fig. 0.1 Help Menu

Help : display the Help. Not supported currently.

Camera Info : display camera information (product name, serial number, version, etc.).

10.1.4 Tab

10.1.4.1 VIEW Tab

Tab to control overall function of camera.

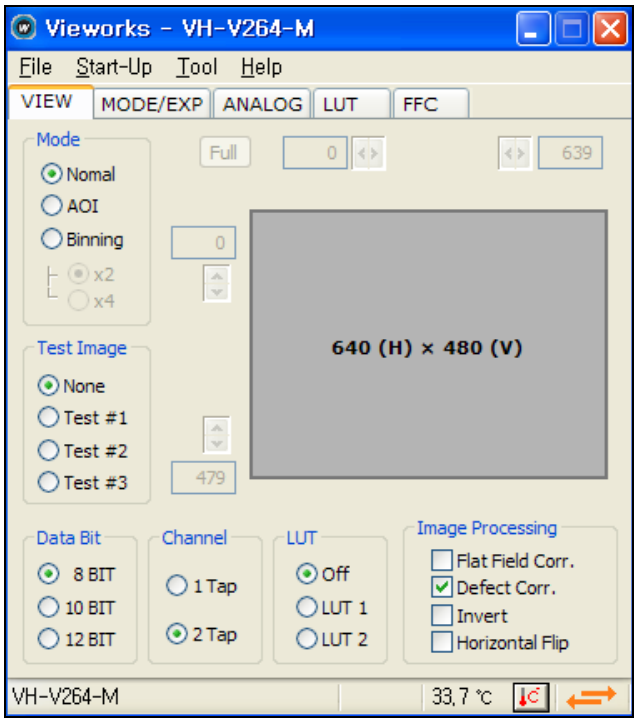


Fig. 0.1 VIEW Tab

Mode : select Readout mode. If AOI is selected, right AOI setting area is activated, and AOI can be set with mouse drag or value input. If Binning is selected, x2, x4 selection is activated.

Test Image : select whether to apply test image and type of test image.

Data Bit : set width of data output.

Channel : set channel mode.

LUT : select whether to apply LUT and type of LUT.

Imaging Processing : set On/Off of Defect Correction, Image Invert, Horizontal Flip function (No Flat Field Correction function)

10.1.4.2 MODE/EXP Tab

Tab to set Trigger mode, exposure time and Strobe. All scroll bars can be adjusted with wheel scroll of mouse.

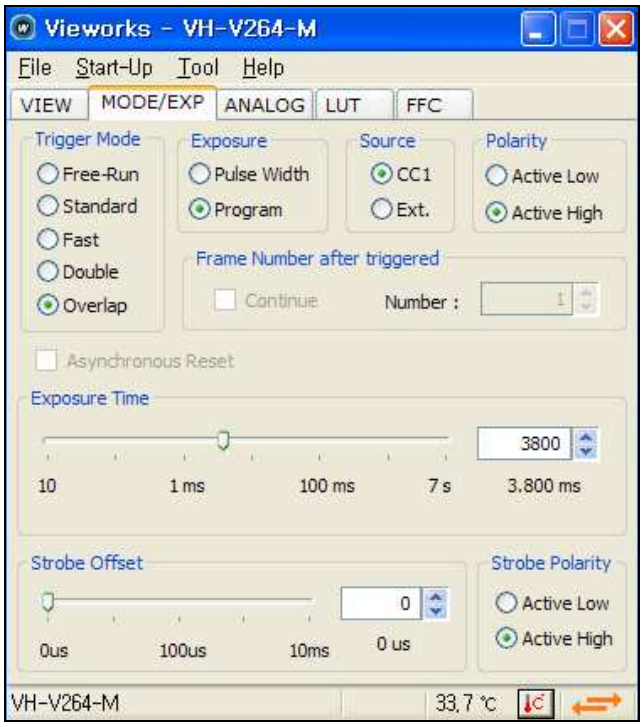


Fig. 0.1 MODE/EXP Tab

Trigger Mode : set Trigger mode. As this mode is selected, related selection areas are activated.

Exposure : select Exposure source.

Source : select Trigger source.

Polarity : select polarity of Trigger input.

Async. Reset : set Async Reset On/Off

Frame Number ... : activated in Standard mode. Set the number of frame to receive after trigger input.

Exposure Time : set Exposure Time to be applied in Free-Run mode and when Exposure source is set with Program.

Strobe Offset : set Strobe Offset.

Strobe Polarity : set polarity of Strobe output signal

10.1.4.3 ANALOG Tab

Tab to set Gain and Offset setting of image. All scroll bars can be adjusted with wheel scroll of mouse.

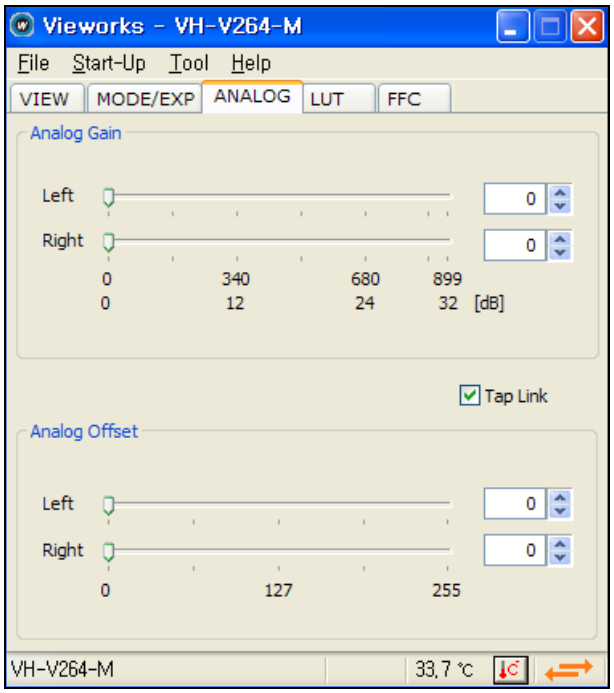


Fig. 0.1 ANALOG Tab

Analog Gain : set Gain value of each channel. If Tap Link item is checked, setting values of both channels change together.

Analog Offset : set Offsetvalue of both channels. If Tap Link item is checked, setting values of both channels change together.

10.1.4.4 LUT Tab

Tab to download LUT data. See Appendix B for more details on download.

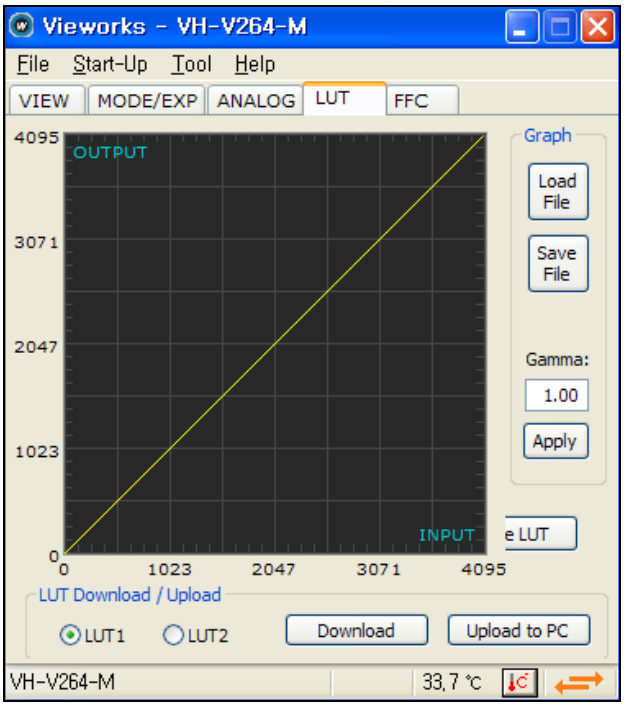


Fig. 0.1 LUT Tab

Graph : load LUT data from user file or set Gamma value to be applied when using Gamma curve.

LUT Download / Upload : download LUT data to camera from user computer (Download) or upload LUT data saved in camera to user computer (Upload to PC).

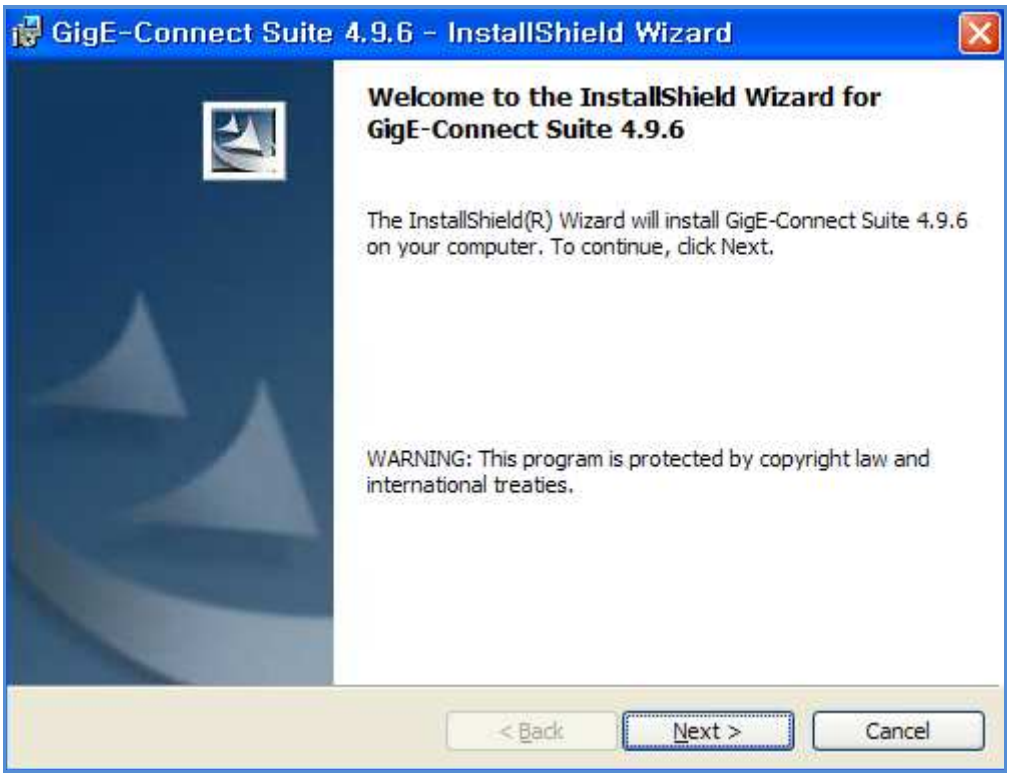
11. GigaCam Installation and Use

GigaCam is the exclusive viewer application for VH GigE industrial camera. It is used for control related to image setting and network environment setting.

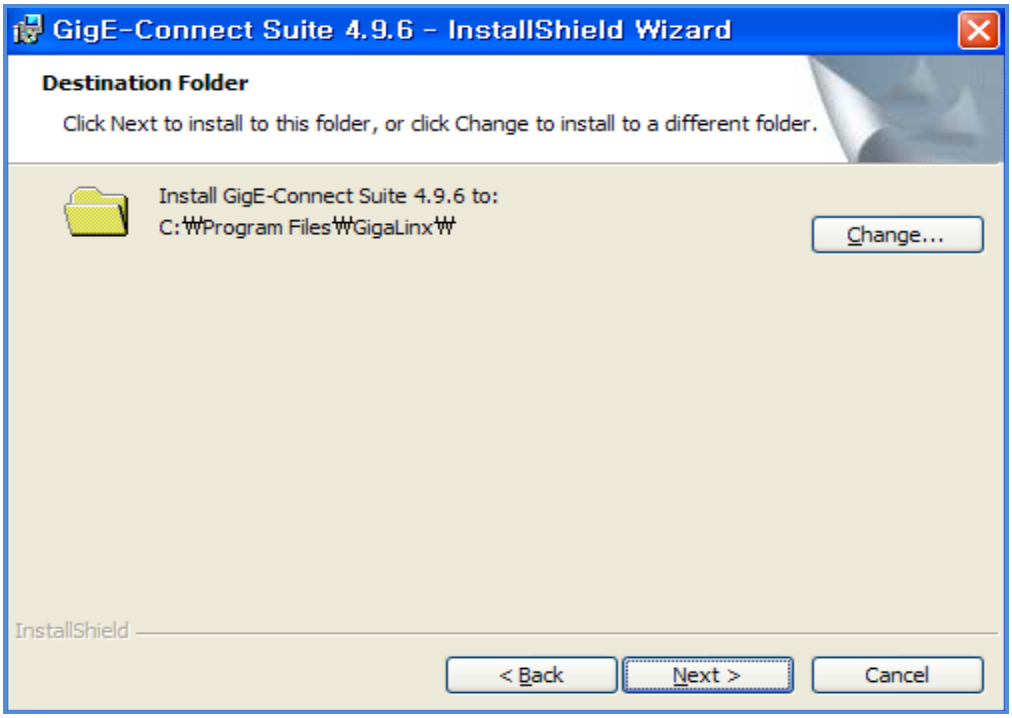
11.1 GigaCam Installation Method

11.1.1 Execute Install File

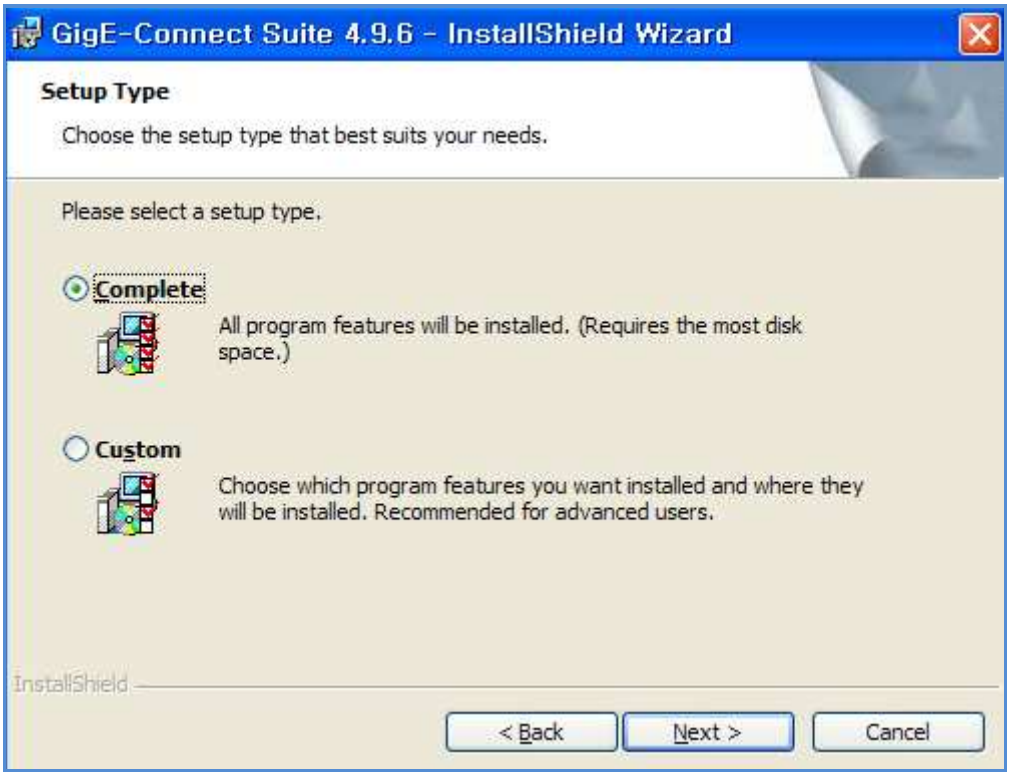
11.1.2 Continue InstallShield Wizard


GigE-Connect Suite 4.9.6 - InstallShield Wizard
Welcome to the InstallShield Wizard for GigE-Connect Suite 4.9.6
The InstallShield(R) Wizard will install GigE-Connect Suite 4.9.6 on your computer. To continue, click Next.
WARNING: This program is protected by copyright law and international treaties.
< Back
Next >
Cancel

11.1.3 Designate Install Directory

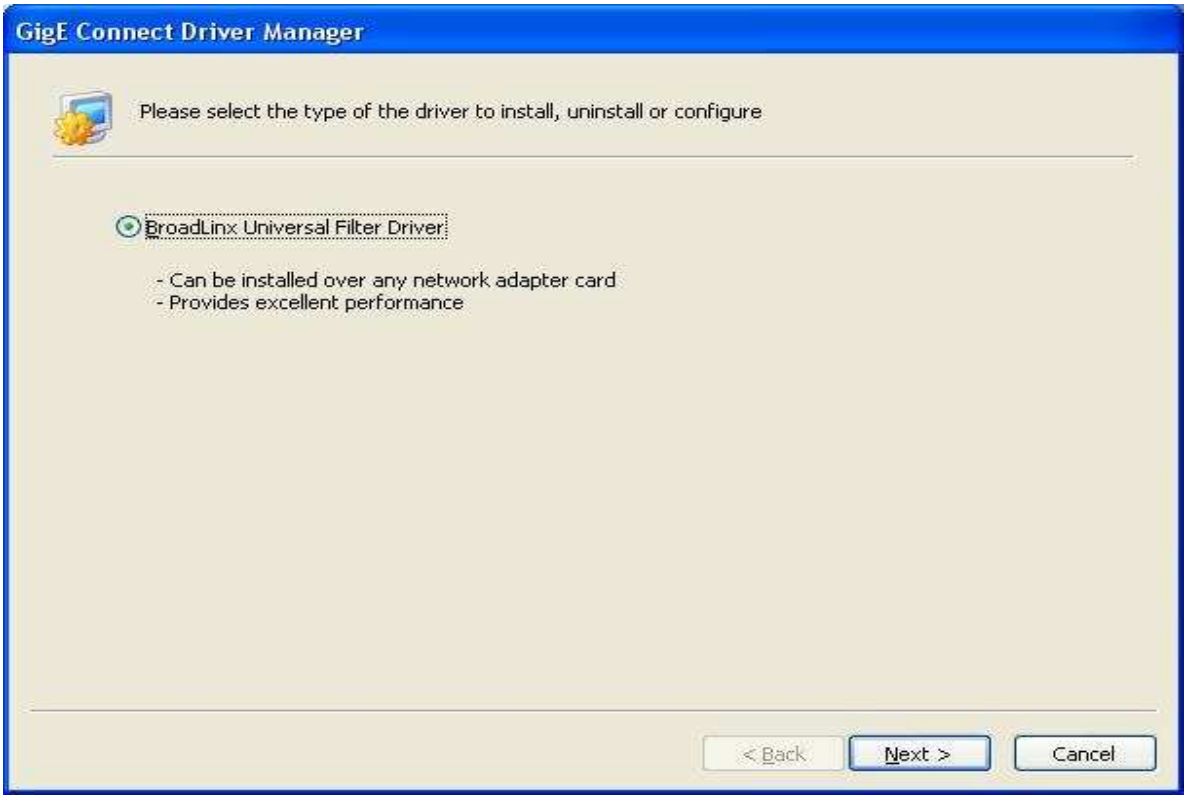

GigE-Connect Suite 4.9.6 - InstallShield Wizard
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
Install GigE-Connect Suite 4.9.6 to:
C:₩Program Files₩GigaLinx₩
Change...
InstallShield
< Back
Next >
Cancel

11.1.4 Select Setup Type (Recommended: Complete)

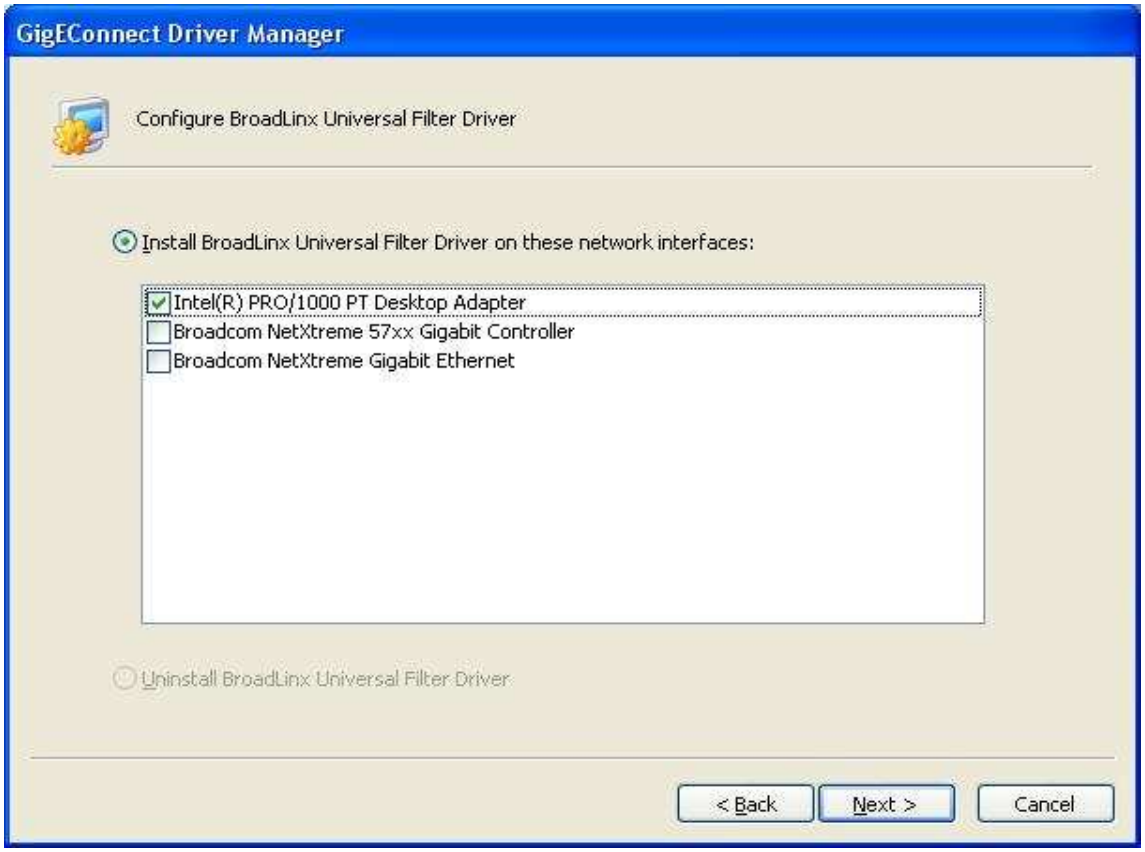

GigE-Connect Suite 4.9.6 - InstallShield Wizard
Setup Type
Choose the setup type that best suits your needs.
Please select a setup type.
Complete
All program features will be installed. (Requires the most disk space.)
Custom
Choose which program features you want installed and where they will be installed. Recommended for advanced users.
InstallShield
< Back
Next >
Cancel

11.1.5 Designate GeniCam Root Path(Click Next)

11.1.6 Select BroadLinx Universal Filter Driver


GigE Connect Driver Manager
Please select the type of the driver to install, uninstall or configure
BroadLinx Universal Filter Driver
- Can be installed over any network adapter card
- Provides excellent performance
< Back
Next >
Cancel

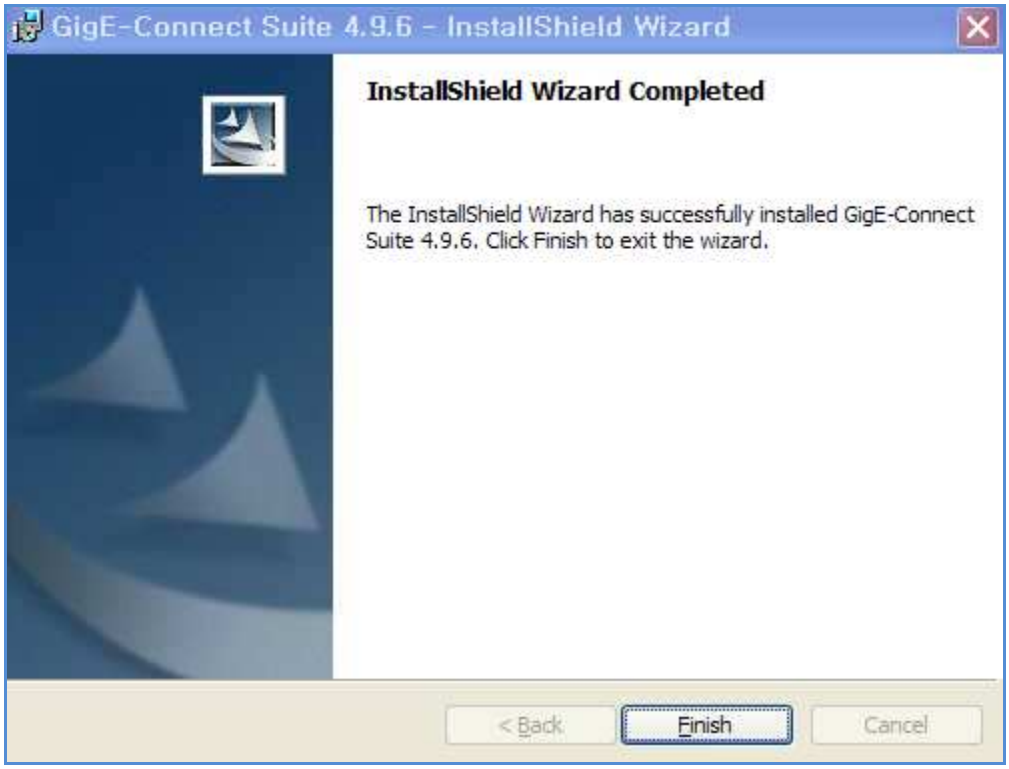
11.1.7 Select the target to install BroadLinx Universal Filter Driver


GigEConnect Driver Manager
Configure BroadLinx Universal Filter Driver
Install BroadLinx Universal Filter Driver on these network interfaces:
Intel(R) PRO/1000 PT Desktop Adapter
Broadcom NetXtreme 57xx Gigabit Controller
Broadcom NetXtreme Gigabit Ethernet
Uninstall BroadLinx Universal Filter Driver
< Back
Next >
Cancel

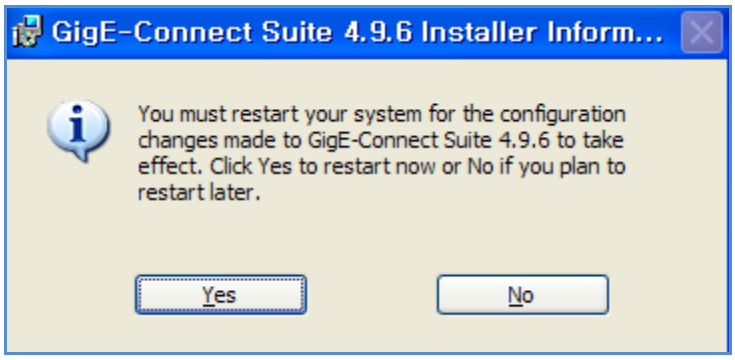
11.1.8 Select Continue if warning popup appears during installation

Software Installation
The software you are installing has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the software vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

11.1.9 Finish installation


GigE-Connect Suite 4.9.6 - InstallShield Wizard
InstallShield Wizard Completed
The InstallShield Wizard has successfully installed GigE-Connect Suite 4.9.6. Click Finish to exit the wizard.
< Back
Finish
Cancel

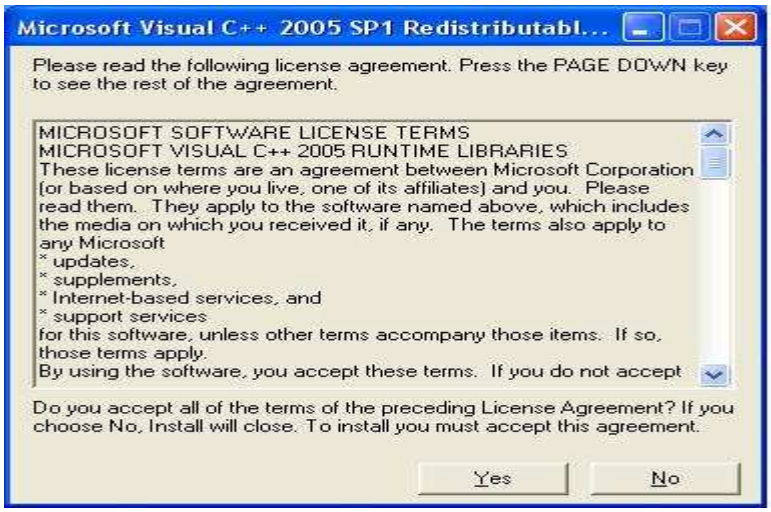
11.1.10 Restart the system


GigE-Connect Suite 4.9.6 Installer Inform...
You must restart your system for the configuration changes made to GigE-Connect Suite 4.9.6 to take effect. Click Yes to restart now or No if you plan to restart later.
Yes
No

11.1.11 Install VS2005 Redistribution Package

11.1.11.1 Execute “scredist_x86.exe”

11.1.11.2 Click Yes (Completed)


Microsoft Visual C++ 2005 SP1 Redistributabl...
Please read the following license agreement. Press the PAGE DOWN key to see the rest of the agreement.
MICROSOFT SOFTWARE LICENSE TERMS
MICROSOFT VISUAL C++ 2005 RUNTIME LIBRARIES
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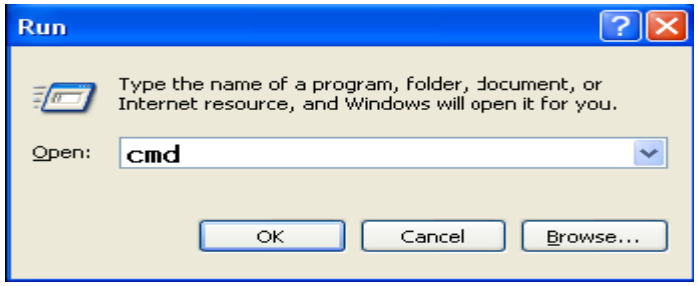
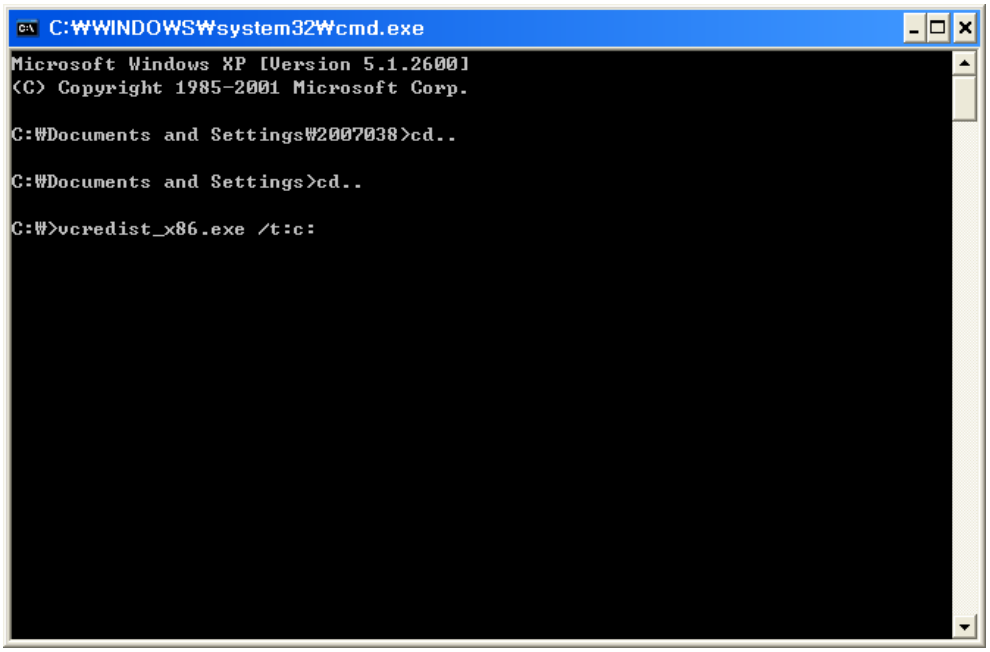
Yes
No

11.1.11.3 If Syntax error occurs

- Save “vcredist_x86.exe” file in C:\ directory
- Open Windows Command window



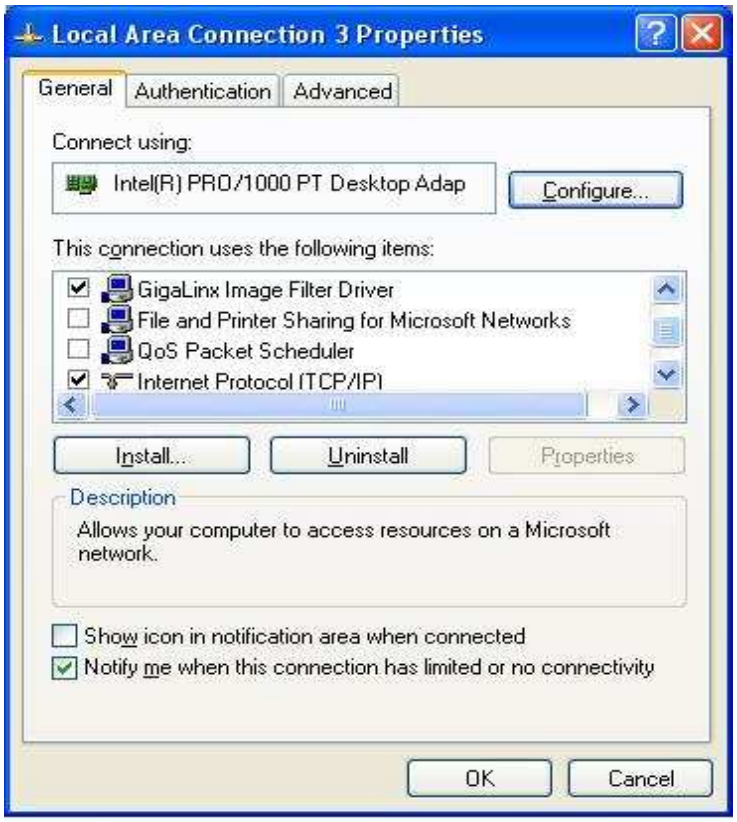
- Execute “vcredist_x86.ext” in C:\



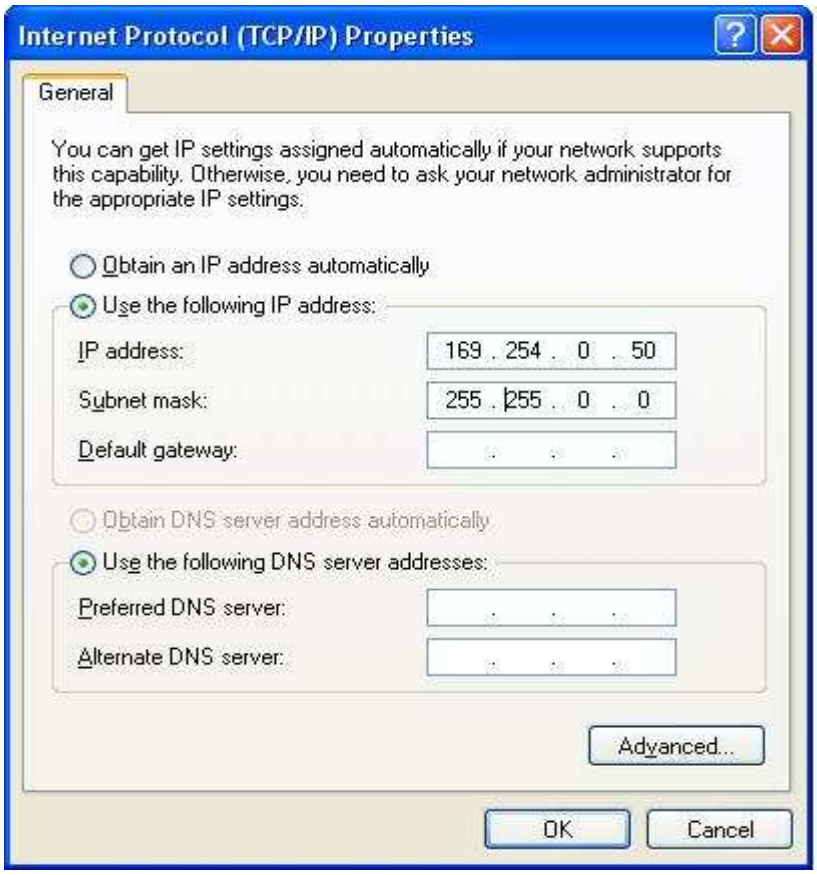
11.2 Network Environment Setting

11.2.1 Change Network Connection Property

- Uncheck except GigaLinx Image Filter Driver, internet protocol (TCP/IP)



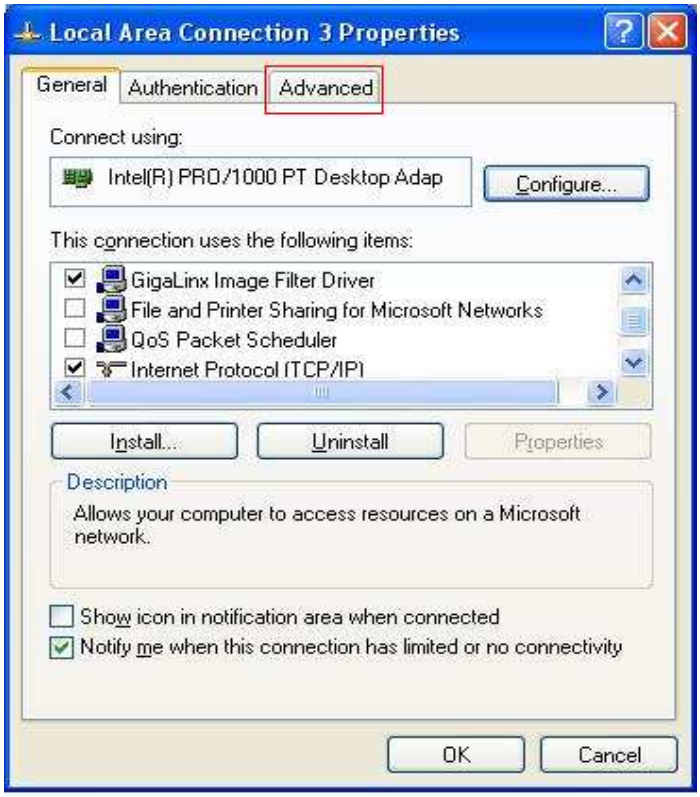
11.2.2 Confirm after Changing Internet Protocol(TCP/IP) Property


Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
169 . 254 . 0 . 50
Subnet mask:
255 . 255 . 0 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

- **IP Address : 169.254.X.Y (X = 0 ~ 255, Y = 50 ~ 255)**
- Subnet Mask : 255.255.0.0

11.2.3 Disable Firewall

11.2.3.1 Click Advanced Tab



11.2.3.2 Click Settings

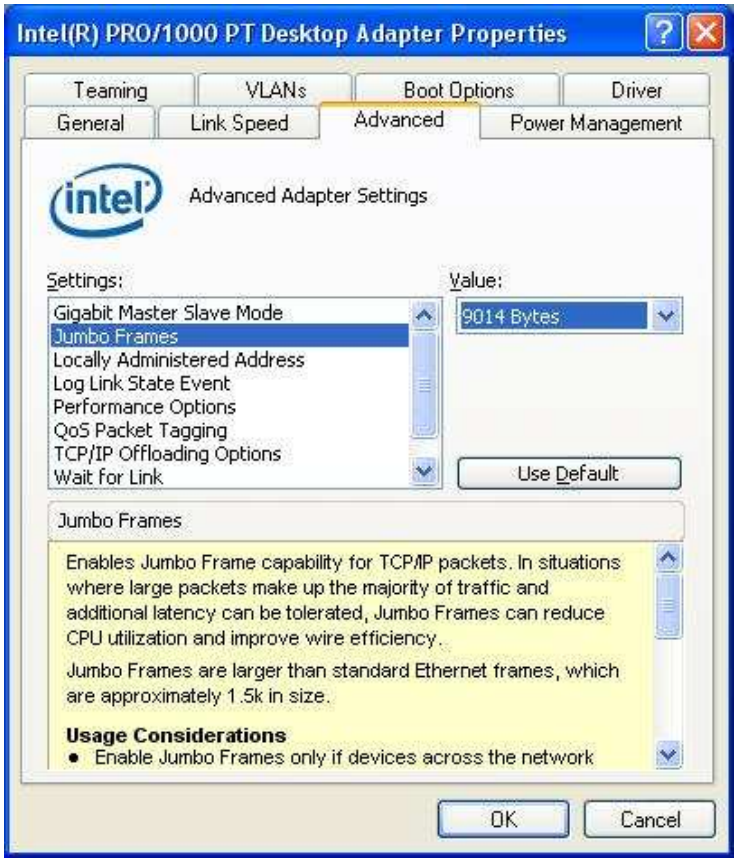
Local Area Connection 3 Properties
General
Authentication
Advanced
Windows Firewall
Protect my computer and network by limiting or preventing access to this computer from the Internet
Settings...
Internet Connection Sharing
Allow other network users to connect through this computer's Internet connection
Home networking connection:
Select a private network connection
Allow other network users to control or disable the shared Internet connection
Learn more about Internet Connection Sharing.
Settings...
If you're not sure how to set these properties, use the Network Setup Wizard instead.
OK
Cancel

11.2.3.3 Click off (not recommended)

Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
What else should I know about Windows Firewall?
OK
Cancel

11.2.4 Configure NIC Driver (Click Configure)

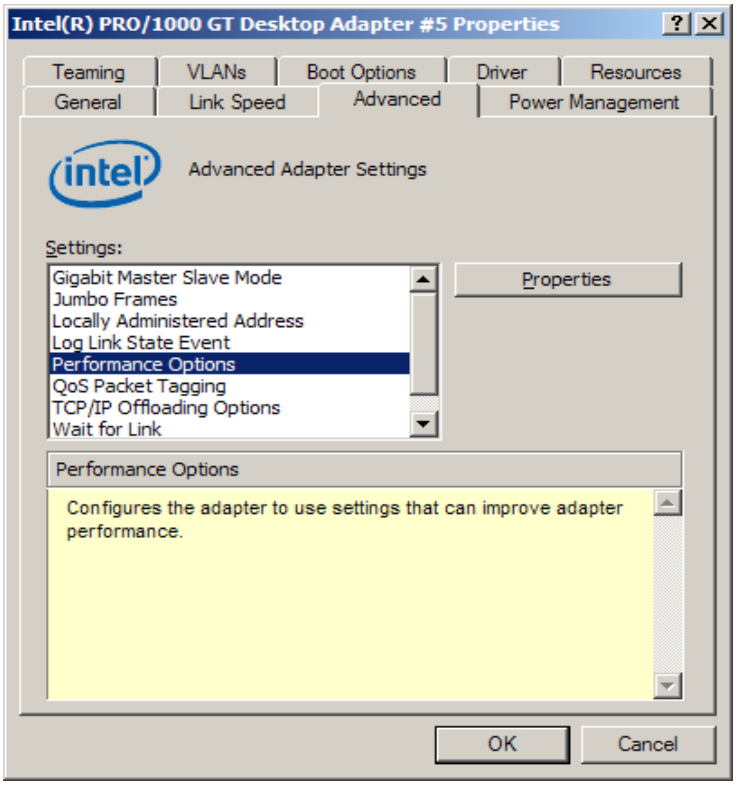
11.2.4.1 Set Jumbo Frame



Select Advanced -> Jumbo frame -> Value : 9014 Bytes

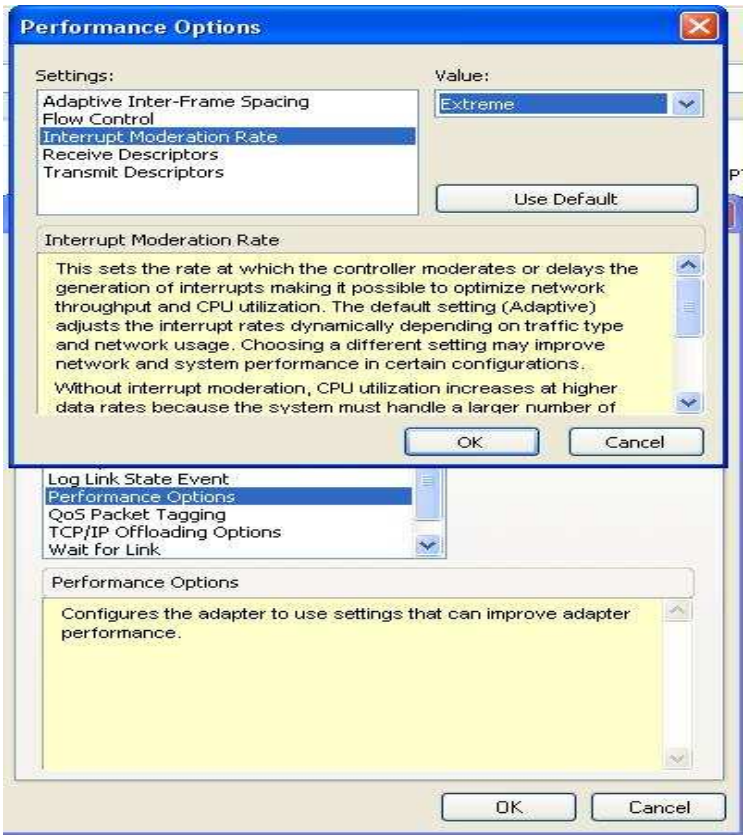
(※Maximum value differs depending on model of network card)

11.2.4.2 Set Performance Option

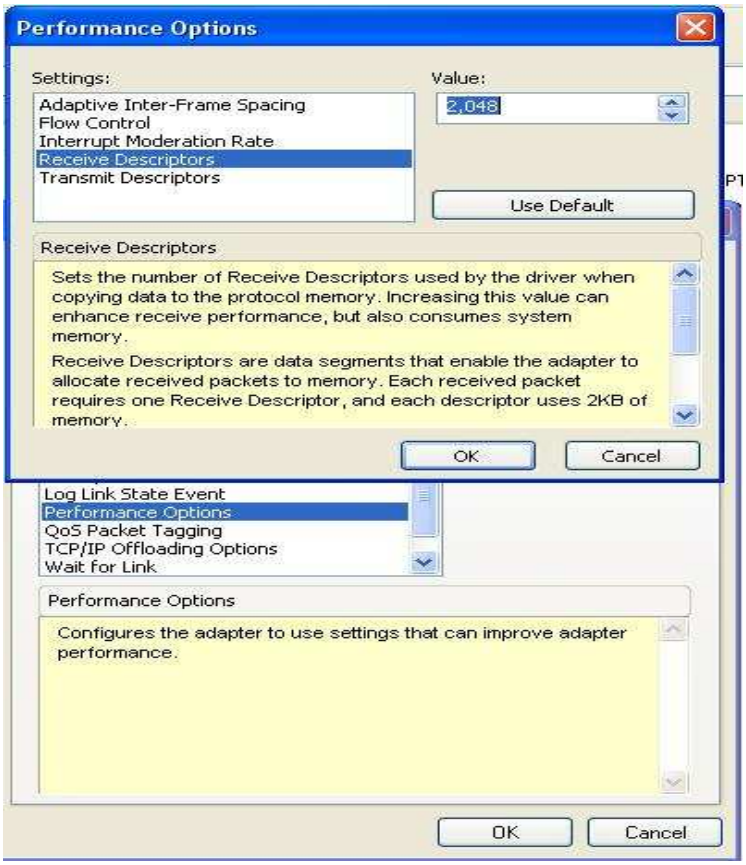


Advanced -> Performance Option -> Registration Information

11.2.4.3 Set Interrupt Moderation Rate at Extreme

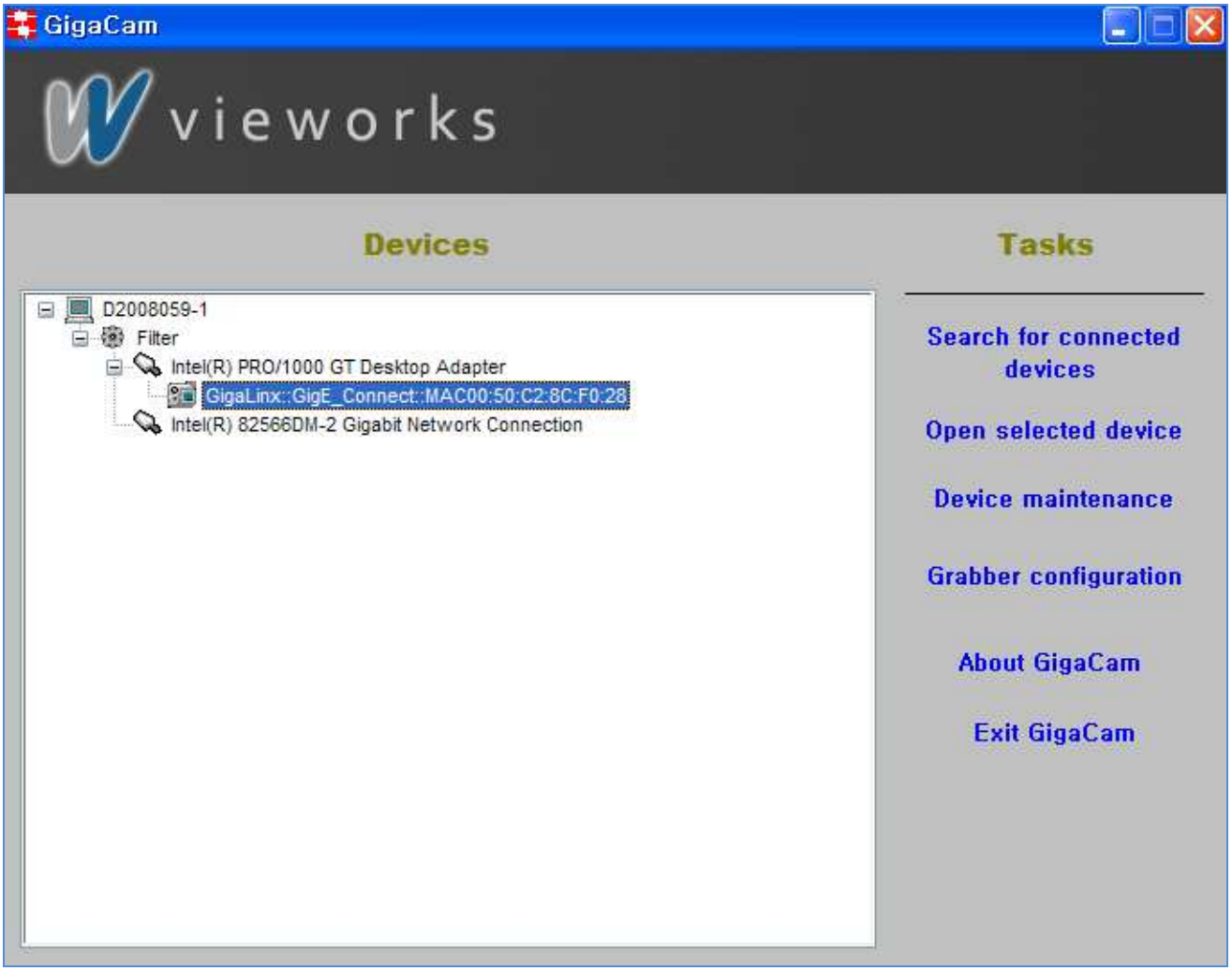

Performance Options
Settings:
Value:
Adaptive Inter-Frame Spacing
Flow Control
Interrupt Moderation Rate
Receive Descriptors
Transmit Descriptors
Extreme
Use Default
Interrupt Moderation Rate
This sets the rate at which the controller moderates or delays the generation of interrupts making it possible to optimize network throughput and CPU utilization. The default setting (Adaptive) adjusts the interrupt rates dynamically depending on traffic type and network usage. Choosing a different setting may improve network and system performance in certain configurations.
Without interrupt moderation, CPU utilization increases at higher data rates because the system must handle a larger number of
OK
Cancel
Log Link State Event
Performance Options
QoS Packet Tagging
TCP/IP Offloading Options
Wait for Link
Performance Options
Configures the adapter to use settings that can improve adapter performance.
OK
Cancel

11.2.4.4 Set Receive Descriptors at 2,048


Performance Options
Settings:
Value:
Adaptive Inter-Frame Spacing
Flow Control
Interrupt Moderation Rate
Receive Descriptors
Transmit Descriptors
2,048
Use Default
Receive Descriptors
Sets the number of Receive Descriptors used by the driver when copying data to the protocol memory. Increasing this value can enhance receive performance, but also consumes system memory.
Receive Descriptors are data segments that enable the adapter to allocate received packets to memory. Each received packet requires one Receive Descriptor, and each descriptor uses 2KB of memory.
OK
Cancel
Log Link State Event
Performance Options
QoS Packet Tagging
TCP/IP Offloading Options
Wait for Link
Performance Options
Configures the adapter to use settings that can improve adapter performance.
OK
Cancel

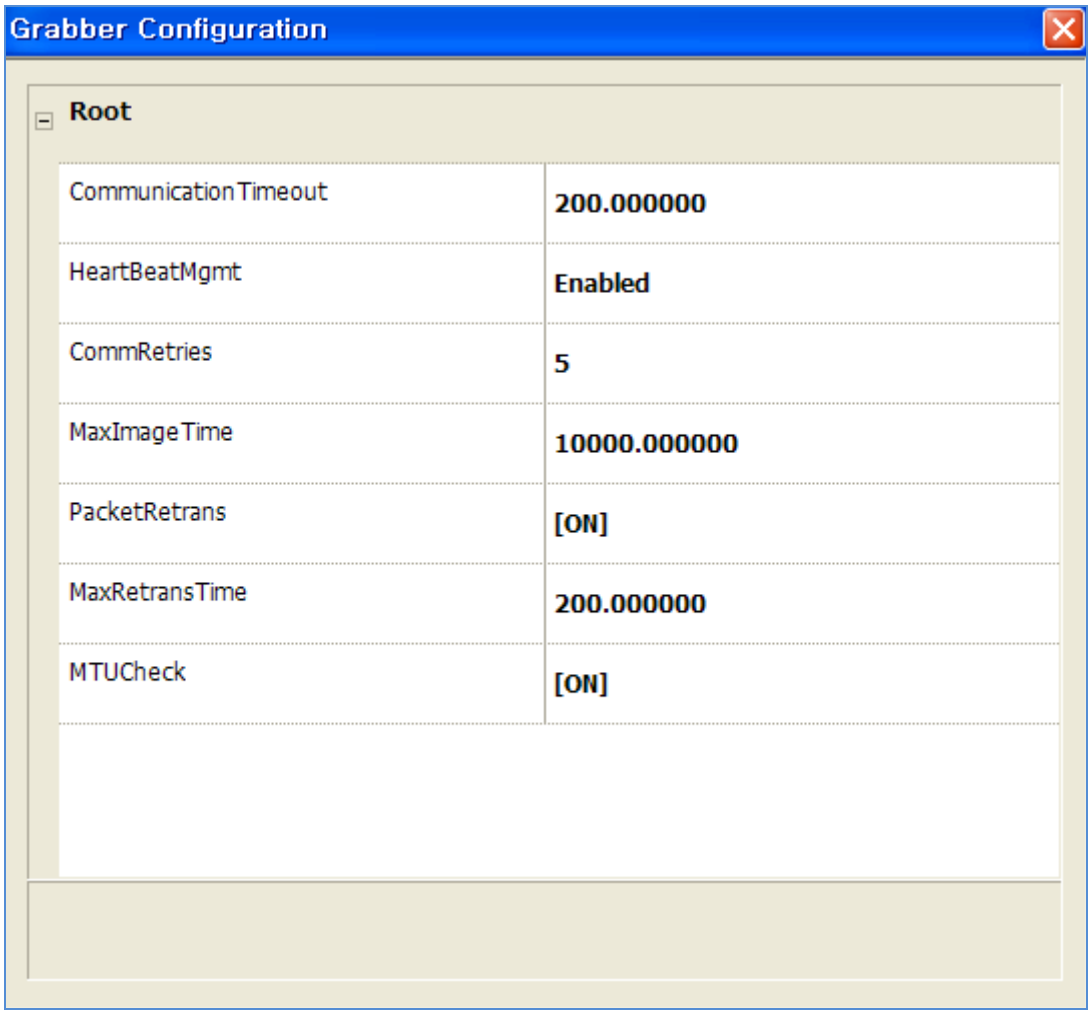
11.3 GigaCam Use

11.3.1 Execute GigaCam Program



- **Search for connected devices** : search for camera connected.
- **Open selected device** : execute camera selected.
- **Device maintenance** : used for updating configuration file.
- **Grabber configuration** : used for changing Grabber configuration.
- **About GigaCam** : check GigaCam version information
- **Exit GigaCam** : exit GigaCam program

11.3.2 Grabber configuration



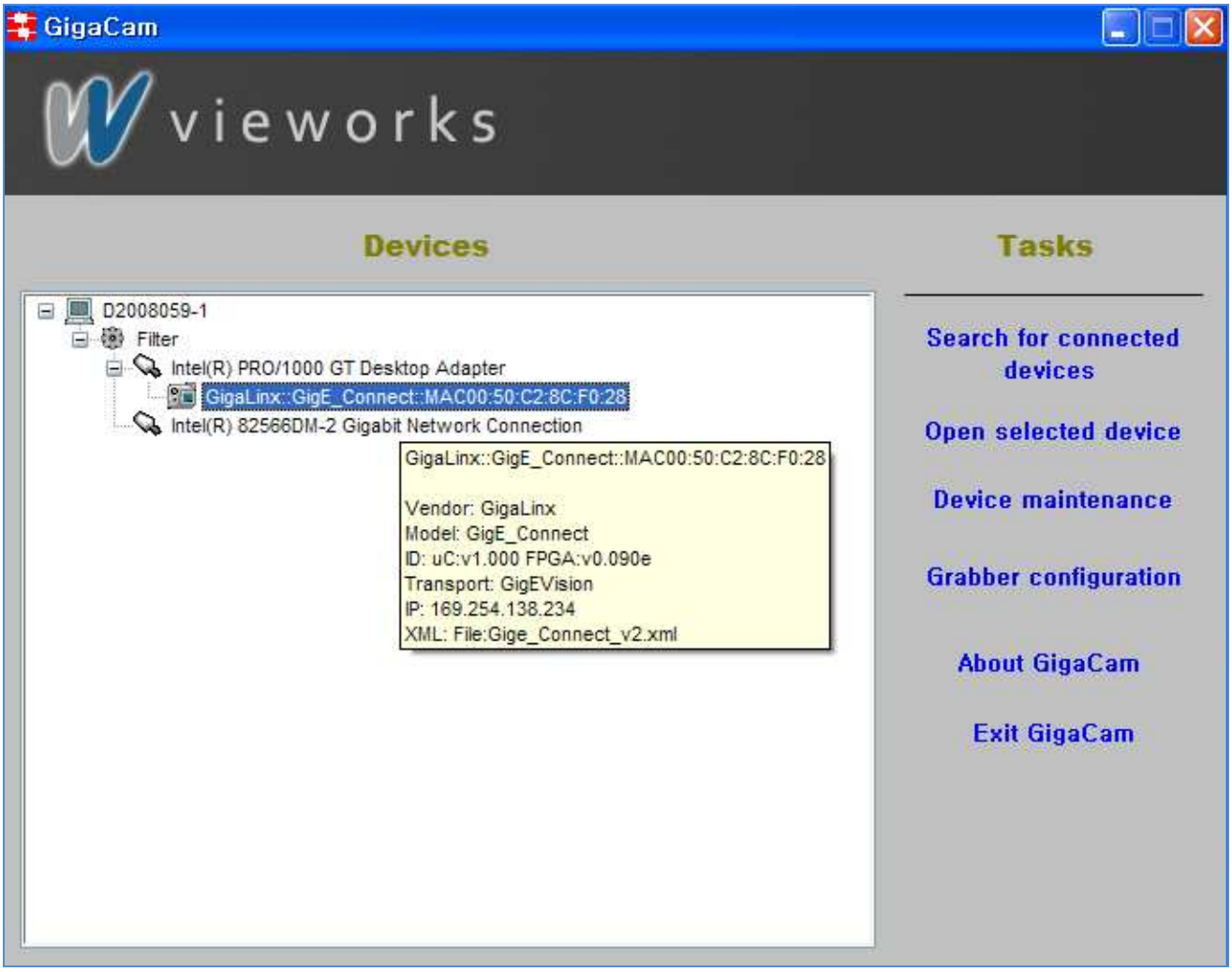
- Communication Timeout : set time for communication Timeout (unit: ms)
- HeartBeatMgmt : set HeartBeat Management (Enabled / Disabled)
- CommRetries : set communication retries (number)
- MaxImage Time : set time for receiving Image data (unit: ms)
- PacketRetrans : set whether to retransmit in case of Packet loss (ON/OFF)
- MaxRetransTime : set retransmission time (unit ms)
- MTUcheck : set Network MTU check (ON/OFF)

Caution) Setting value of Grabber Configuration should be changed depending on HeartBeatTimeout setting value.

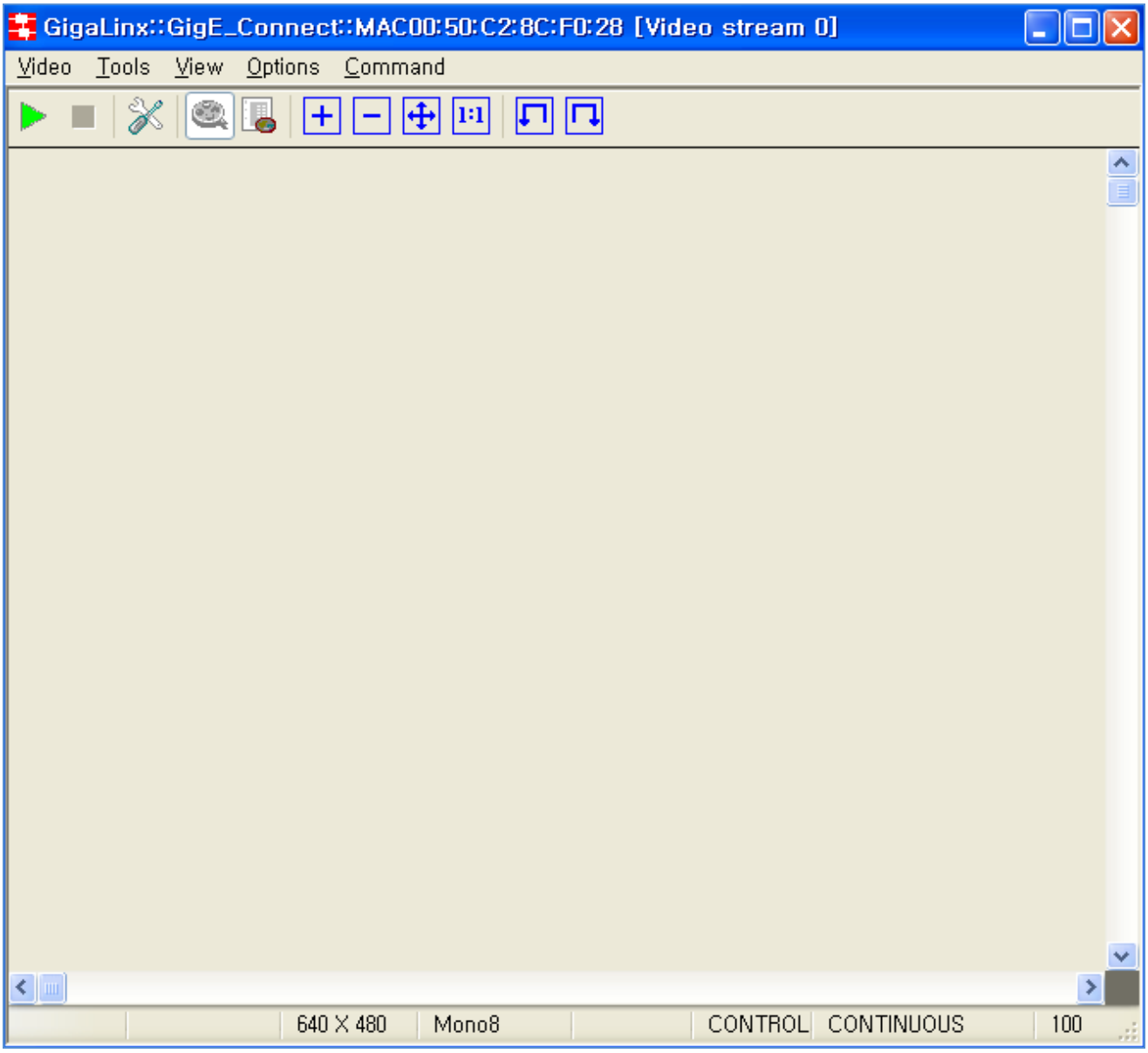
Ex. If HeartBeatTimeout = 1000 (ms), Communication Timeout = 100 (ms)

CommRetries = 5 (times)

11.3.3 Select Camera Connected, and Click Open Selected Device



11.3.4 Open Video Streaming Window



11.3.4.1 Video

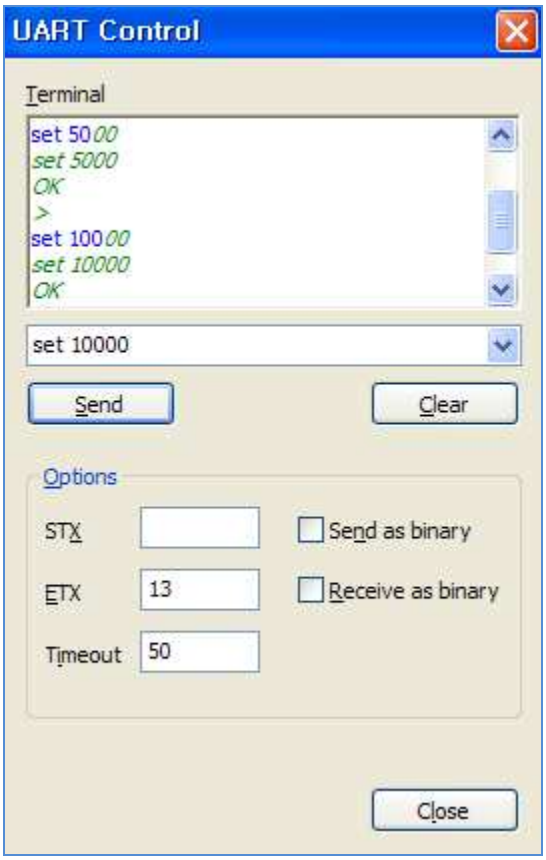
- Play : play image

- Stop : stop image

- Open video stream: not used

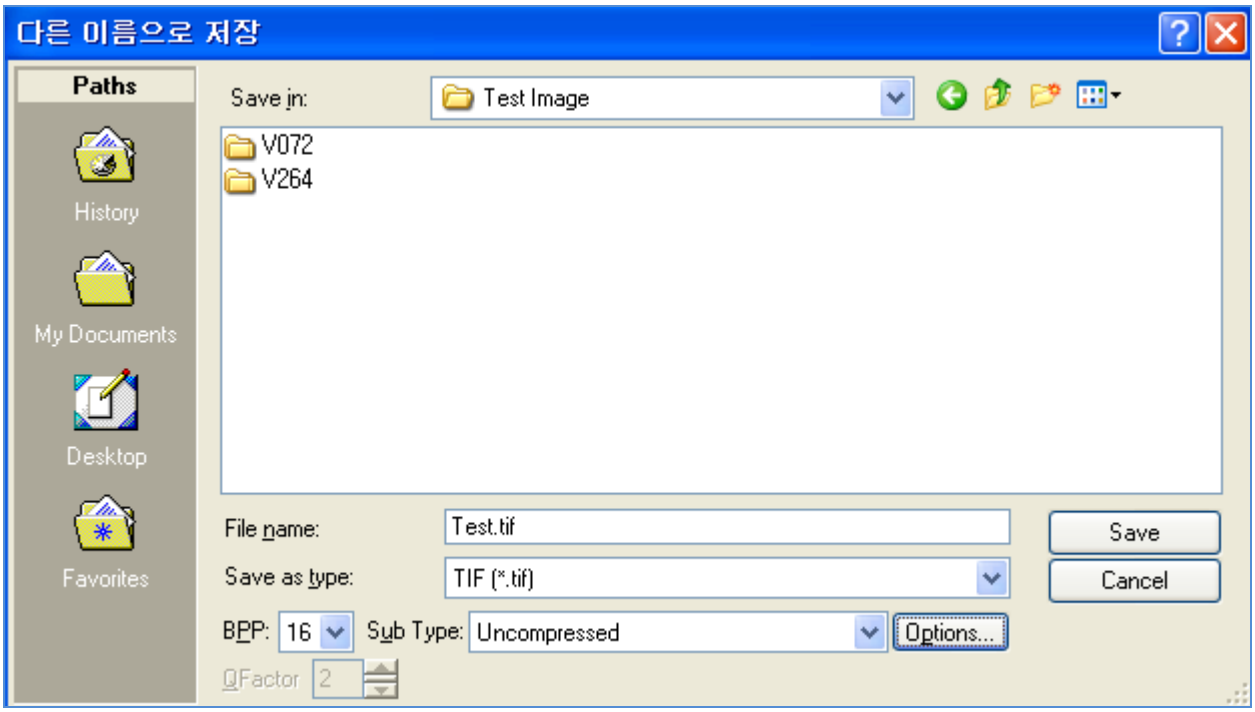
11.3.4.2 Tools

- UART control : can change all settings of camera to command form through Serial interface



Ex) set 10000 : change exposure time to 10ms

- Save snapshot : Image capture function



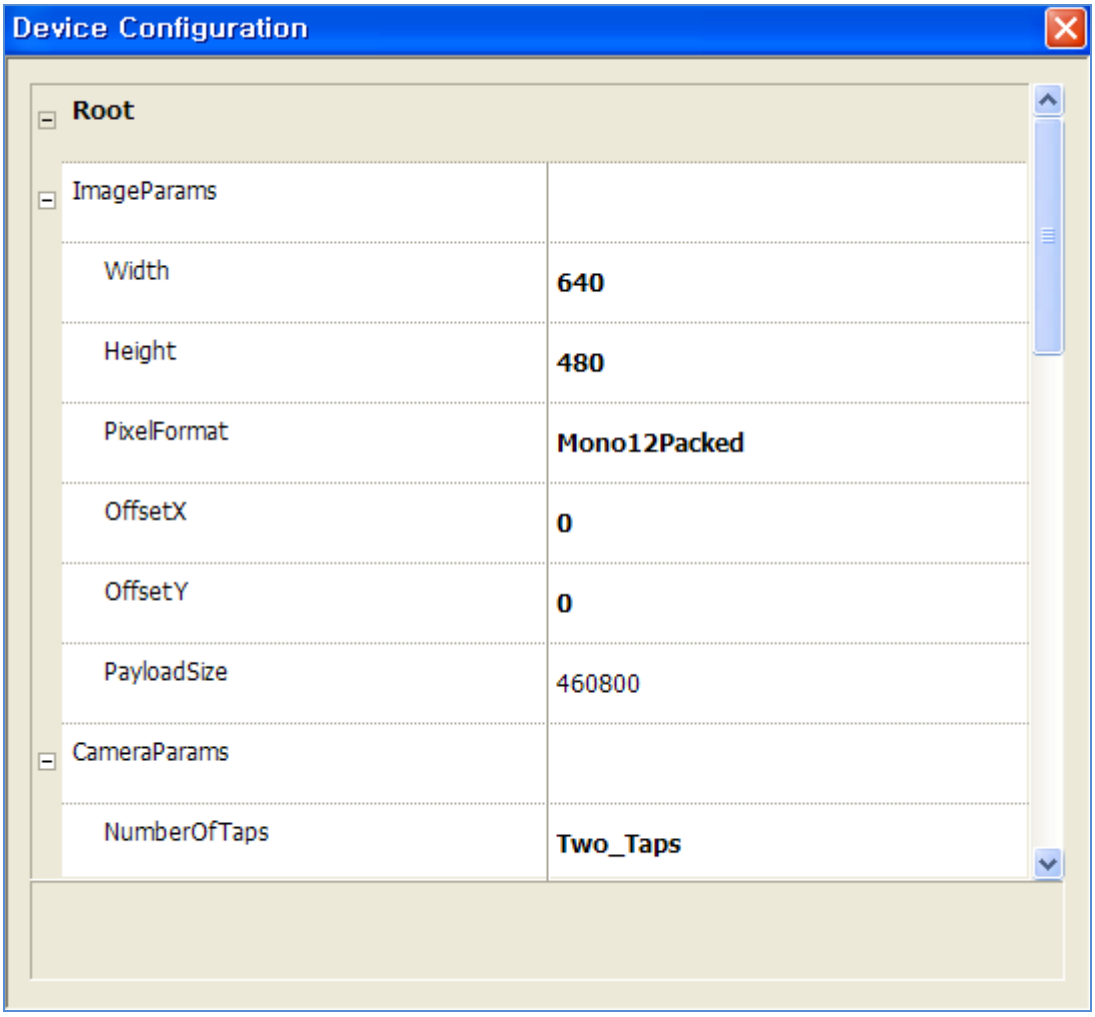
- Device configuration -> Export : save as Device configuration environment setting file (*.dcf)

-> Import : get Device configuration environment setting (*.dcf)

- Configurator : execute Camera Control program

11.3.4.3 View

- Device Parameters



- Width : Image columns (Horizontal Pixels)
- Height : Image Rows (Vertical Pixels)
- PixelFormat : Data Output (ex. Mono8, mono12Packed)
- OffsetX : X offset setting if ROI used
- OffsetY : Y offset setting if ROI used
- PayloadSize : packet image size (Read only)
- NumberOfTaps : channel mode setting (ex. One_Tap, Two_Taps)
- LineAreaCamera : select CCD scan type
- GevSCPS_PacketSize : set Image Packet size (set to fit maximum value of NIC jumbo frame)
  (ex. Intel PRO/1000 GT model : jumbo frame (16128Byte) => can be set to maximum(15000))
- InterPacketDelay : Delay setting between Image packet
- BandwidthMBps : Video Bandwidth setting

- DHCPEnabled : automatically assign IP through DHCP server
- PersistentIP : can set Static IP
- IP_PersistentIPaddress : Static IP setting
- IP_PersistentIPsubnet : Subnet Mask setting
- PixelFrequency : Not supported
- UARTbitrate : UARTbitrate setting (use 19200bps)
- HeartbeatMode : network communication ACK function
- HeartbeatTimeout : Device Reset if there is no HeartbeatResponse in setting value
  (ex. 3000 => Device Reset if there is no Heartbeat Response in 3 seconds
- IgnoreDVAL : ignore DVAL (Enable)
- AcquisitionMode : obtain Image Frame (ex. Continuous : obtain image continuously)
- AccessMode
- ProgramEnable : select whether to save in Parameter setting value in non-volatile memory
- SaveParameters : Save in non-volatile memory

※ **Save Parameter setting value in non-volatile memory:**
ProgramEnable => Set as Enable, SaveParameters => Execute

- Video : if not checked, image is not displayed.

- Statistics : display information related to Image capture.

- Zoom -> Zoom in : expand Image

-> Zoom out : reduce Image

-> Fit to window : adjust the size of image to fit Window

-> Actual Pixels : adjust the image to fit actual size

- Rotate -> Left 90° : rotate Image 90°to the left

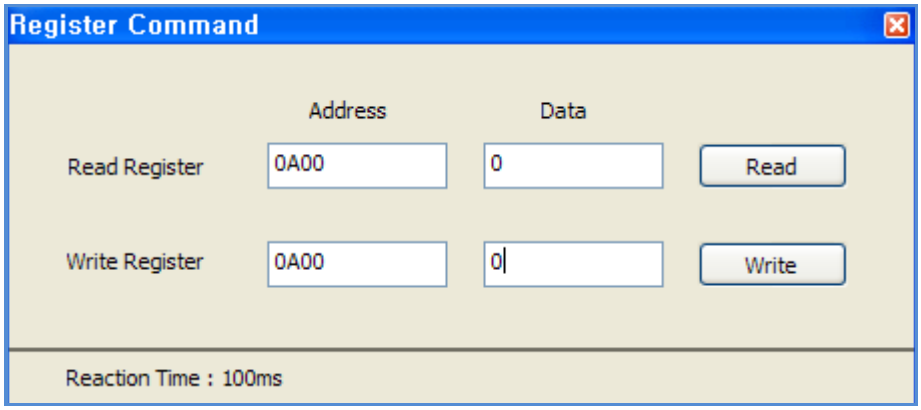
-> Right 90° : rotate Image 90°to the right

11.3.4.4 Options

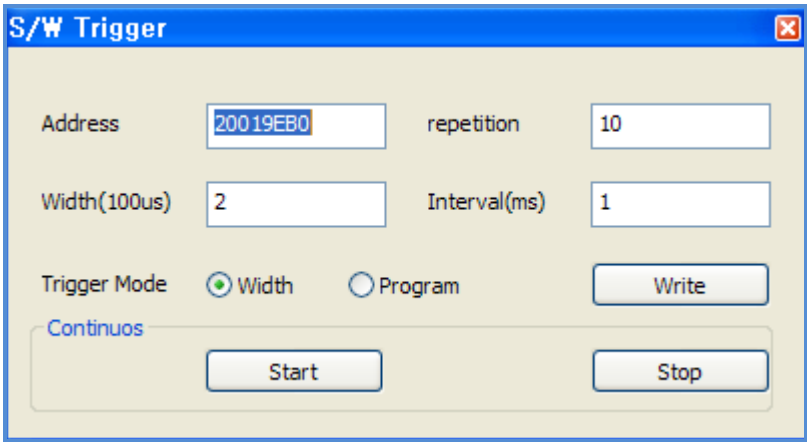
- Image timeout : close acquisition port and display when the image is not acquired for the time set.
- Buffer size : set the Image buffer size of GigaCam application.
- Multicast address
- Max. display FPS : set maximum framerate displayed on the screen

11.3.4.5 Command

- Register : directly access to Gigabit FPGA Register



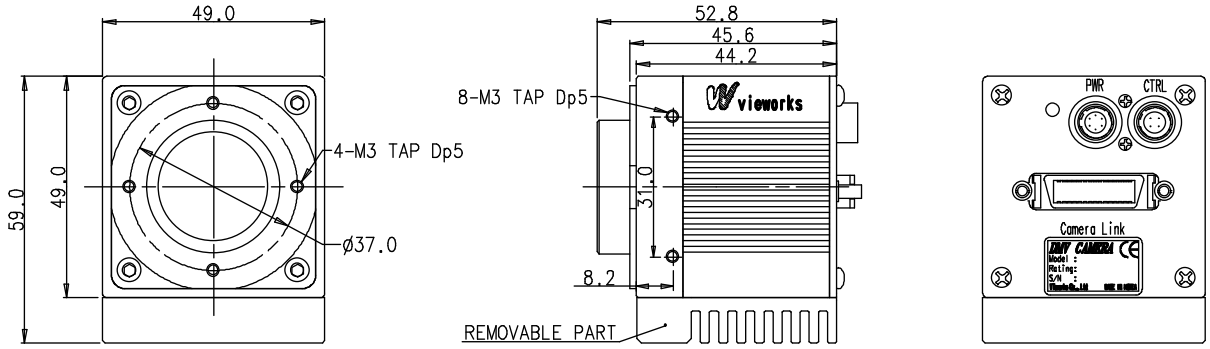
- Trigger : generate S/W Trigger signal.



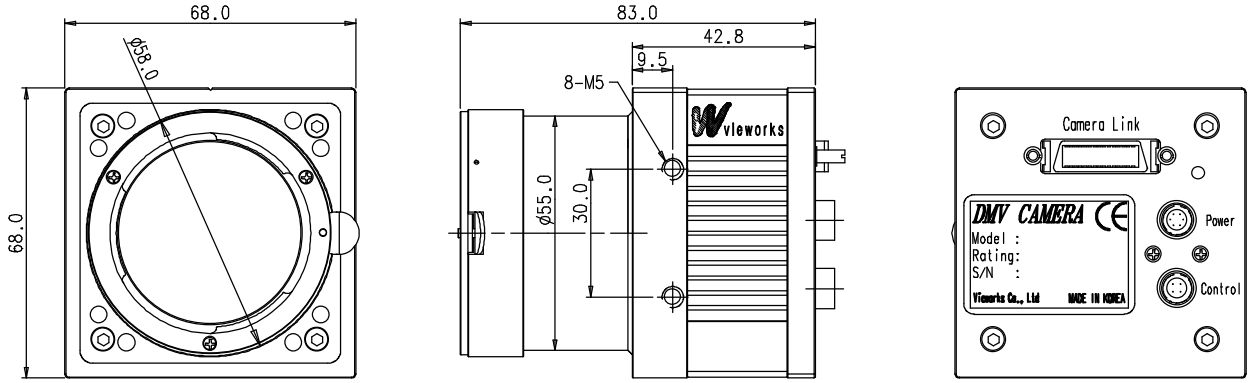
12.Mechanical Spec

12.1 Specification of External Appearance

<VGA C-Mount>



<F-Mount>



<C-Mount>

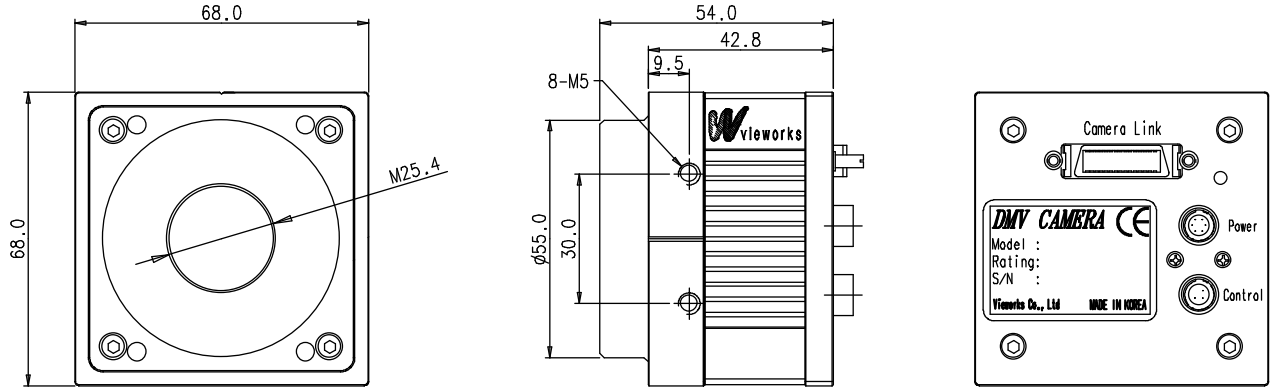
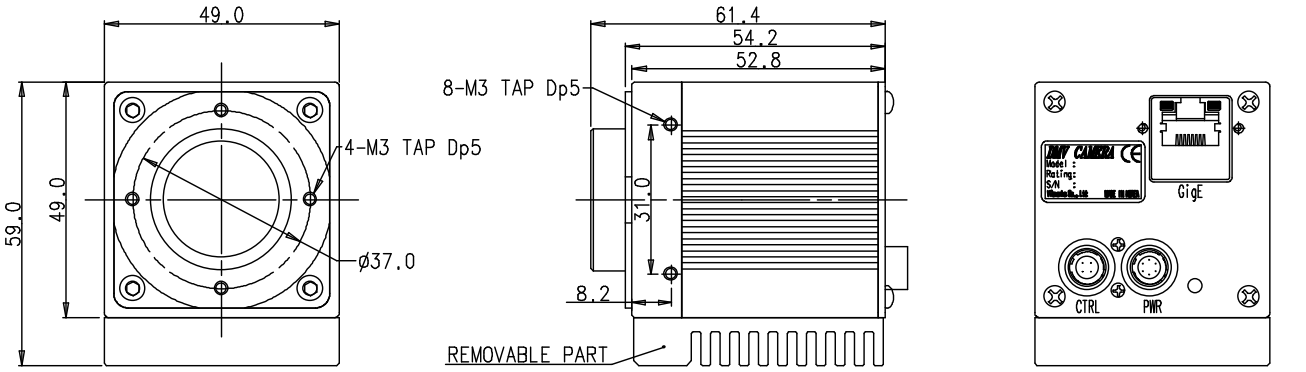
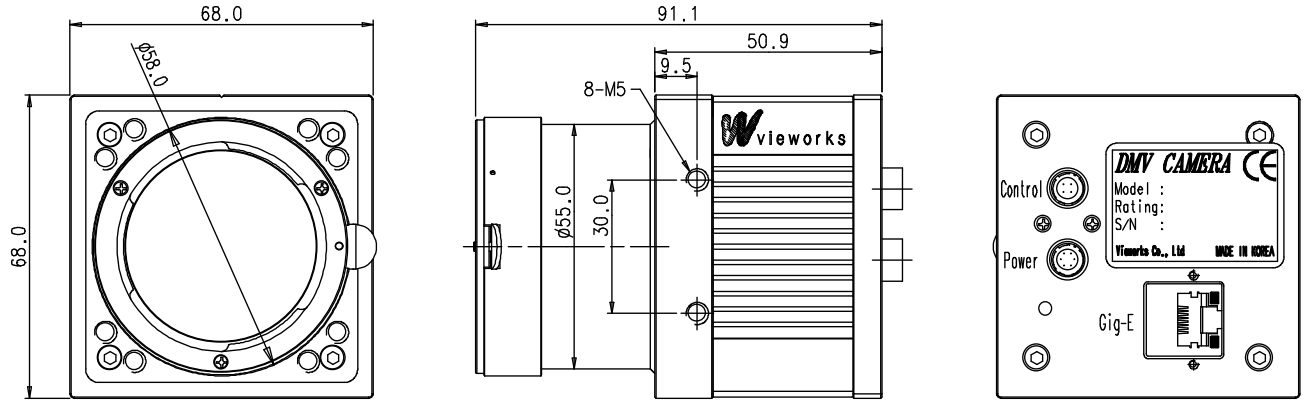


Fig. 12.1 VH Camera Link Mechanical Dimensions

<VGA C-Mount>



<F-Mount>



<C-Mount>

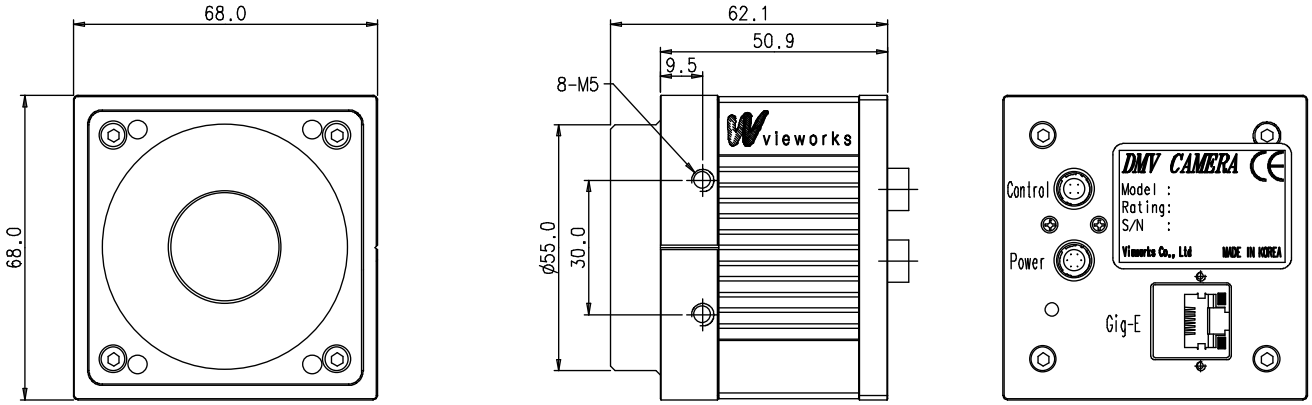


Fig. 12.2 VH GigE Mechanical Dimensions

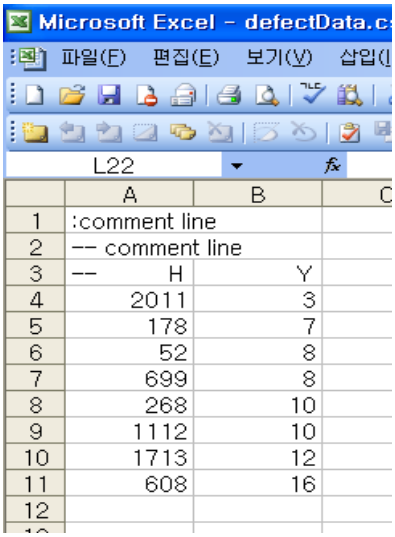
Appendix A Defective Pixel Map Download

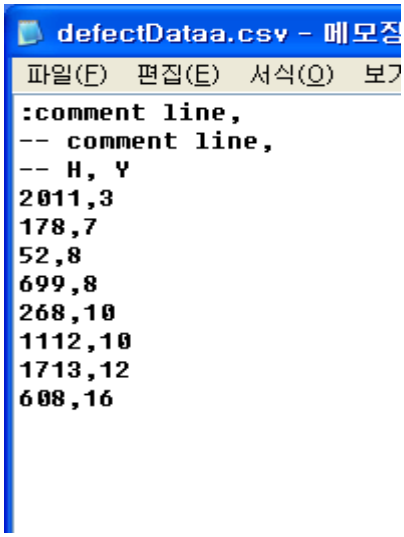
1. Create Defective Pixel Map data in Excel as shown in the following left figure and save as CVS file(*.csv). Right figure shows image that appears when you open the created file in the note pad. Rules applied for creation are as follows:

Lines starting with ':' or '—' are processed as annotation.

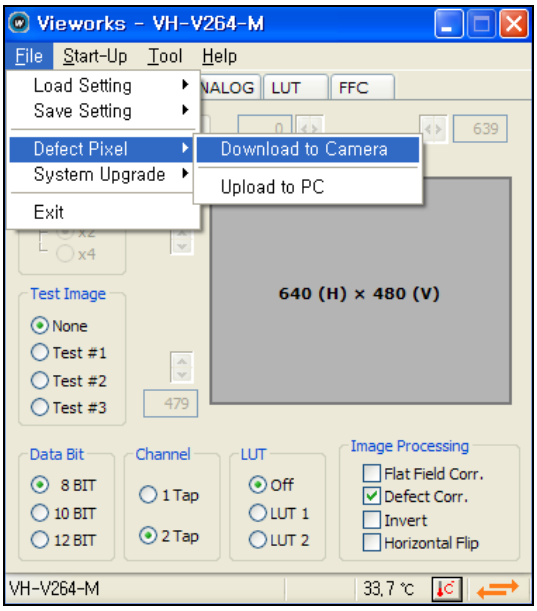
Each line has horizontal coordinate and vertical coordinate in the order.

It is not related to pixel input order.

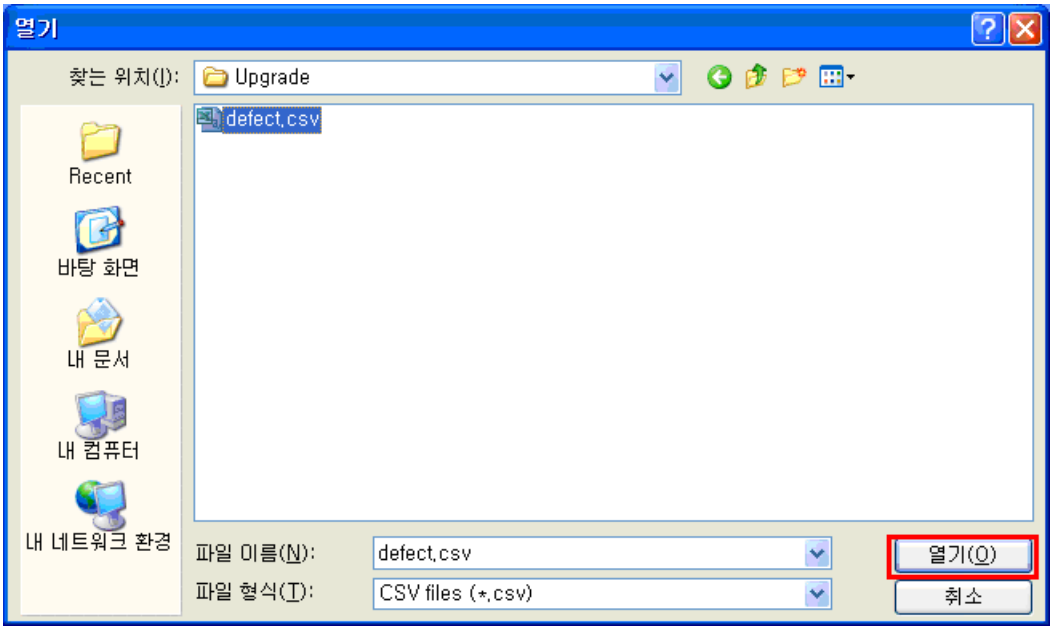




2. Select File -> Defect Pixel -> Download to Camera in program.

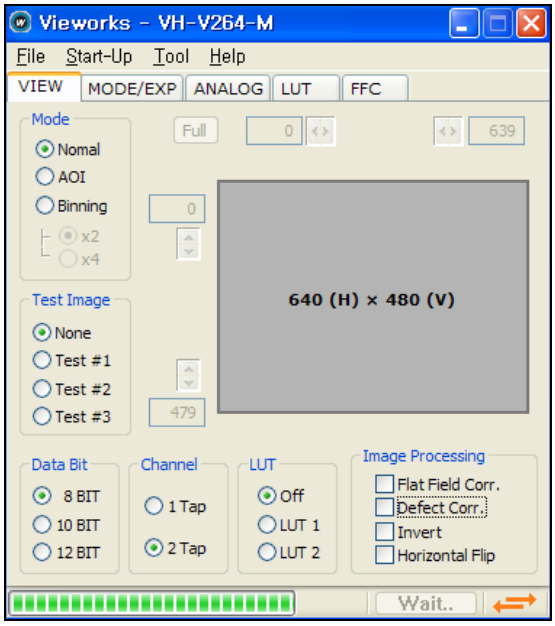


3. In File Dialog, select the file created and press Open button.

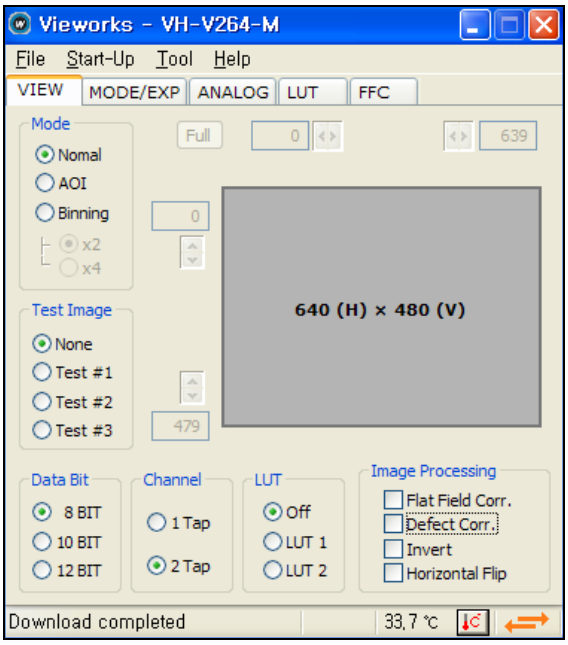


4. Transmission to camera starts and the progress is displayed on the bottom.

When transmission is completed and message “Wait..” appears on the bottom and saving is in progress. Be careful not to disconnect the power while saving is in progress.



5. When all processes are completed, message “Download completed” appears on the bottom.

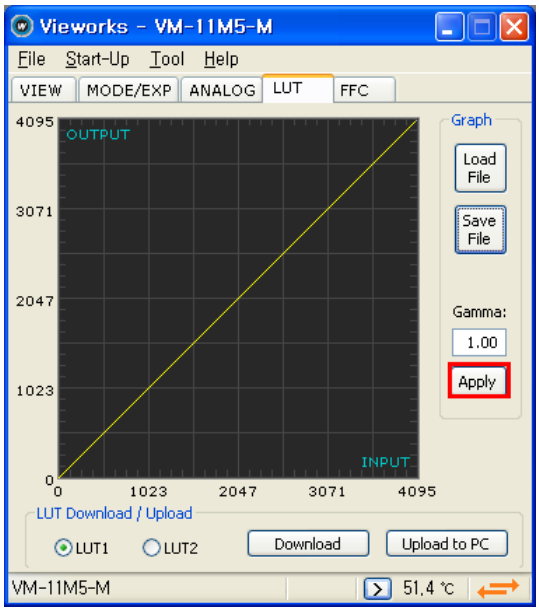


Appendix B LUT Download

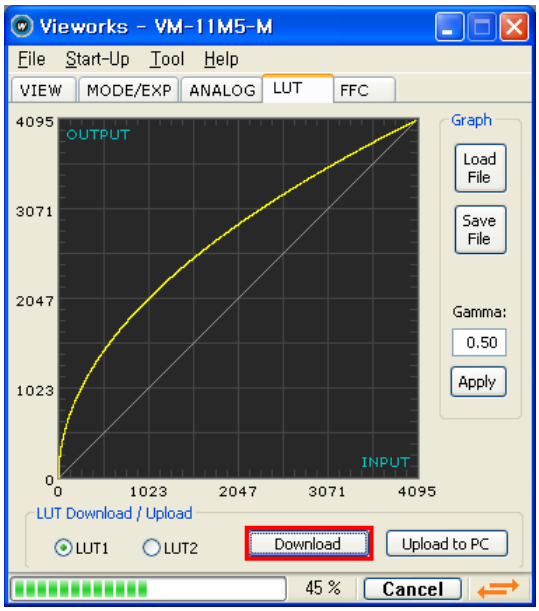
LUT data can be created in 2 methods. Download it after adjusting gamma value in gamma curve in the program provided, or get CSV file(*.csv) created in Excel and download.

B.1 Download Gamma Curve

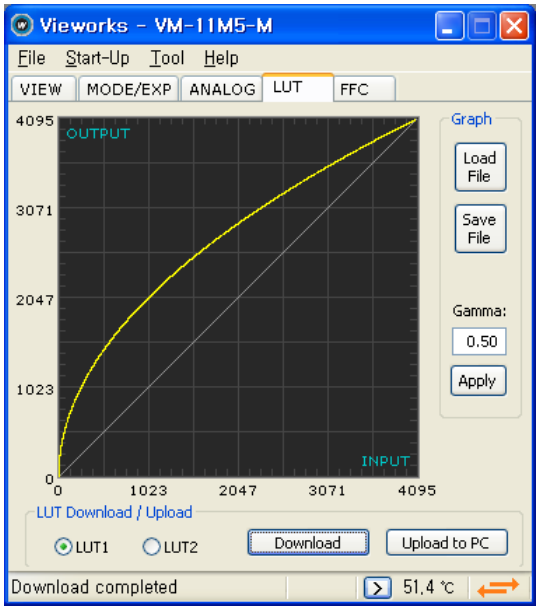
1. Set gamma value you want in LUT Tab of program and press Apply button.



2. Select LUT Download button after selecting the position to save in LUT1 and LUT2.



3. When download is completed, message “Download completed” is displayed as shown below

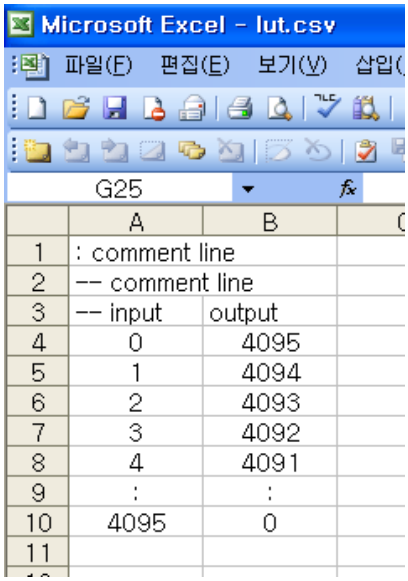


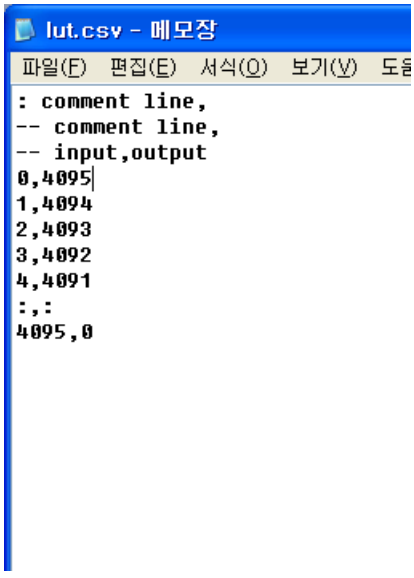
B.2 Download CSV File

1. Create LUT table in EXCEL as shown in the following figure and save them as CVS file(*.csv). Right figure shows the image when you open created file in note pad. To open the file in the program, extension of CVS file should be changed to.lut. Following rules are applied for creation of file.

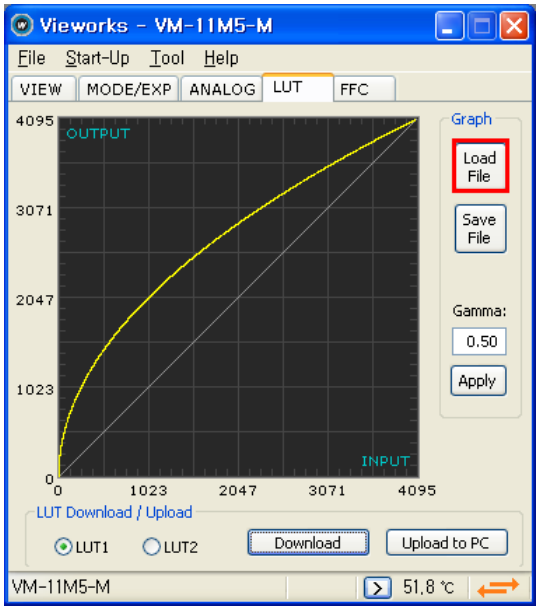
Lines starting with ':' or '—' are processed as annotation.

It should be recorded in the order of 0 to 4095 from input value.

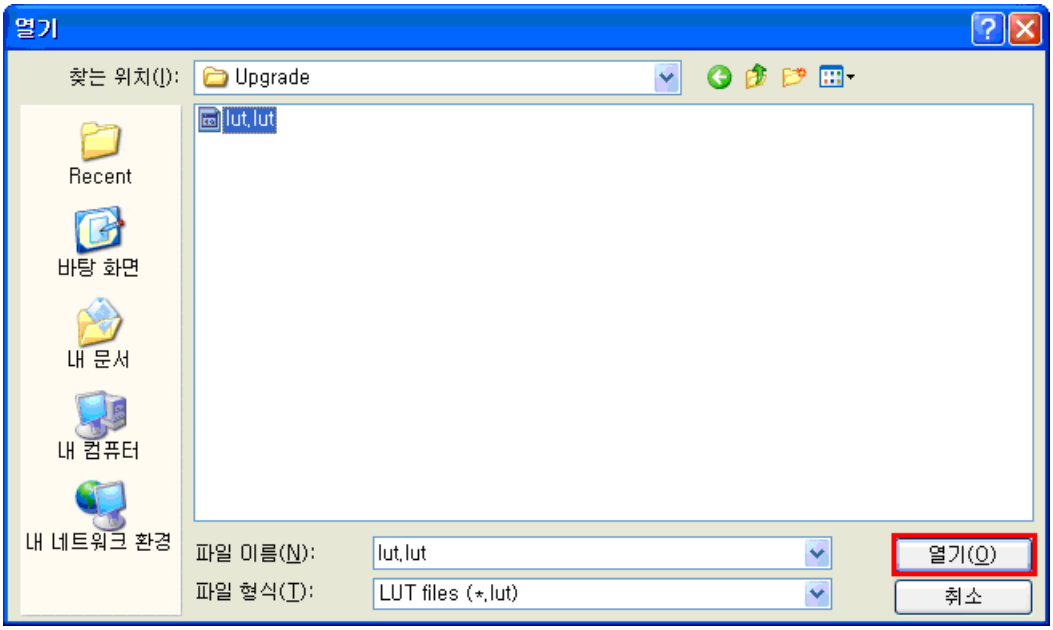




2. Press Load File button in LUT Tab of program.



3. In File Dialog, select LUT file created and press Open button.

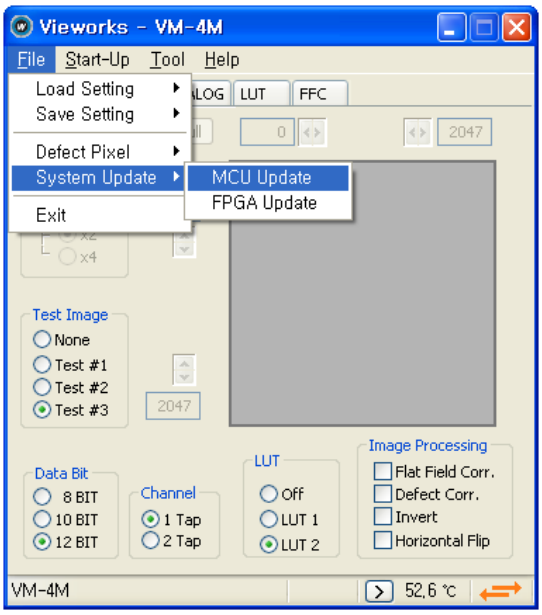


4. Select the location to save and press LUT Download button. Subsequent process is same as the process for gamma curve download.

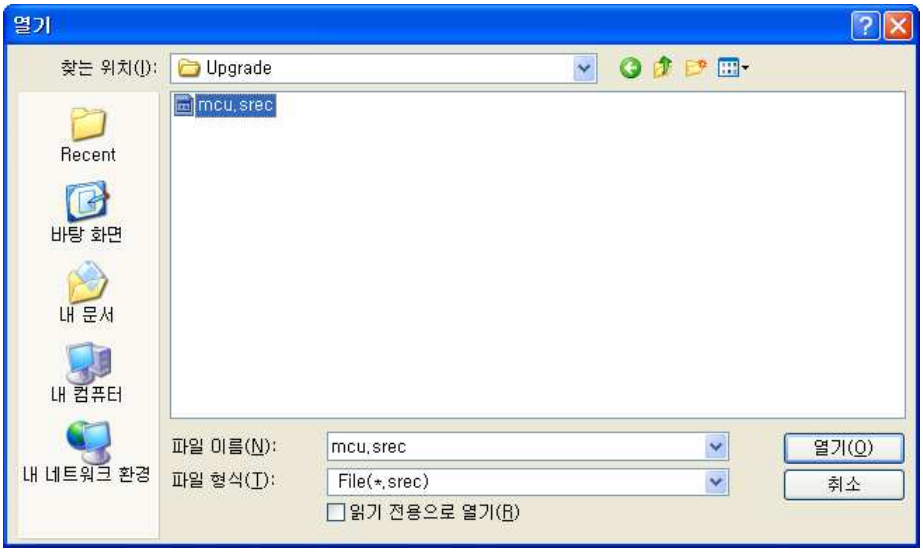
Appendix C Field Upgrade

C.1 MCU

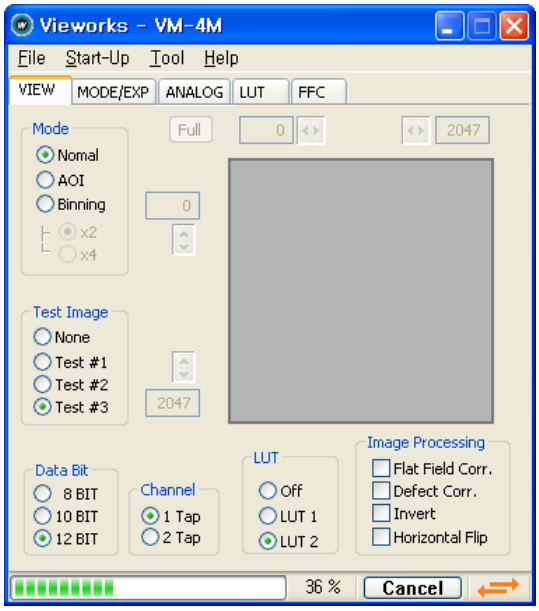
1. Select File -> System Update -> MCU Update in the program selected.



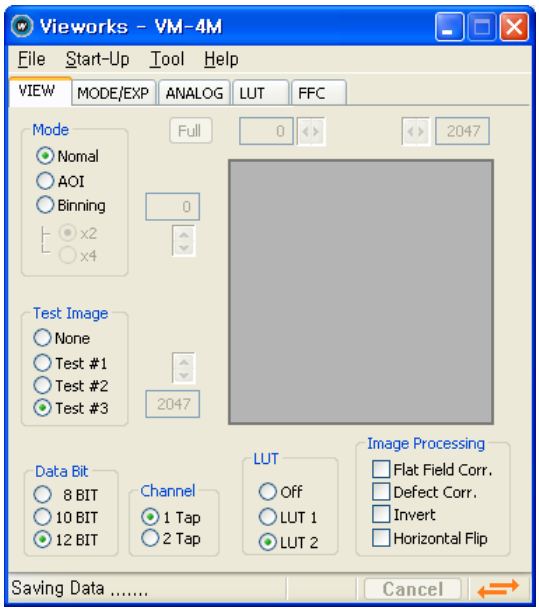
2. Select MCU update file(*.srec) provided in File Dialog, and press Open button.



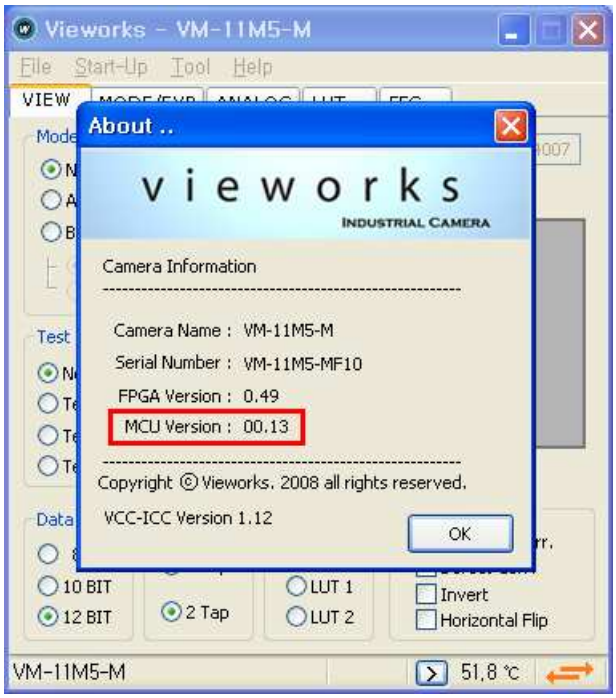
3. Download progress is displayed on the bottom of program. Press Cancel button to cancel this upgrade. It takes several minutes to complete this process.



4. When upgrade file is completely downloaded, it is actually saved in flash. Be careful not to disconnect power cable in the process since camera cannot be restored if this process fails.

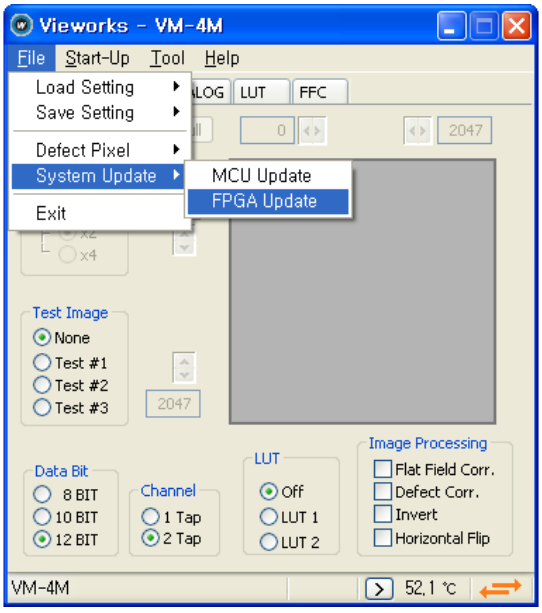


5. When download is completed, turn off and on the power again, click Camera Info under Help Menu and check whether MCU version is properly changed.

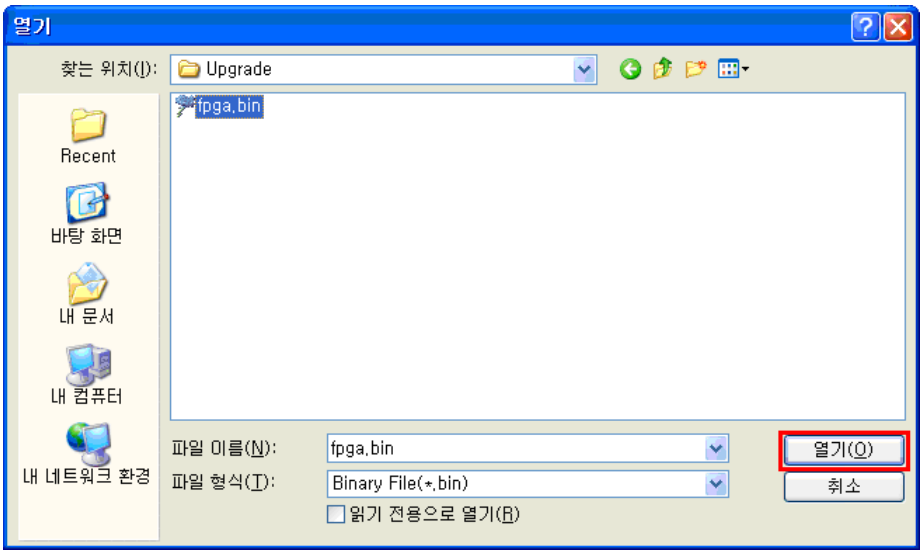


C.2 FPGA

1. Select File -> System Update -> FPGA Update in the program provided.



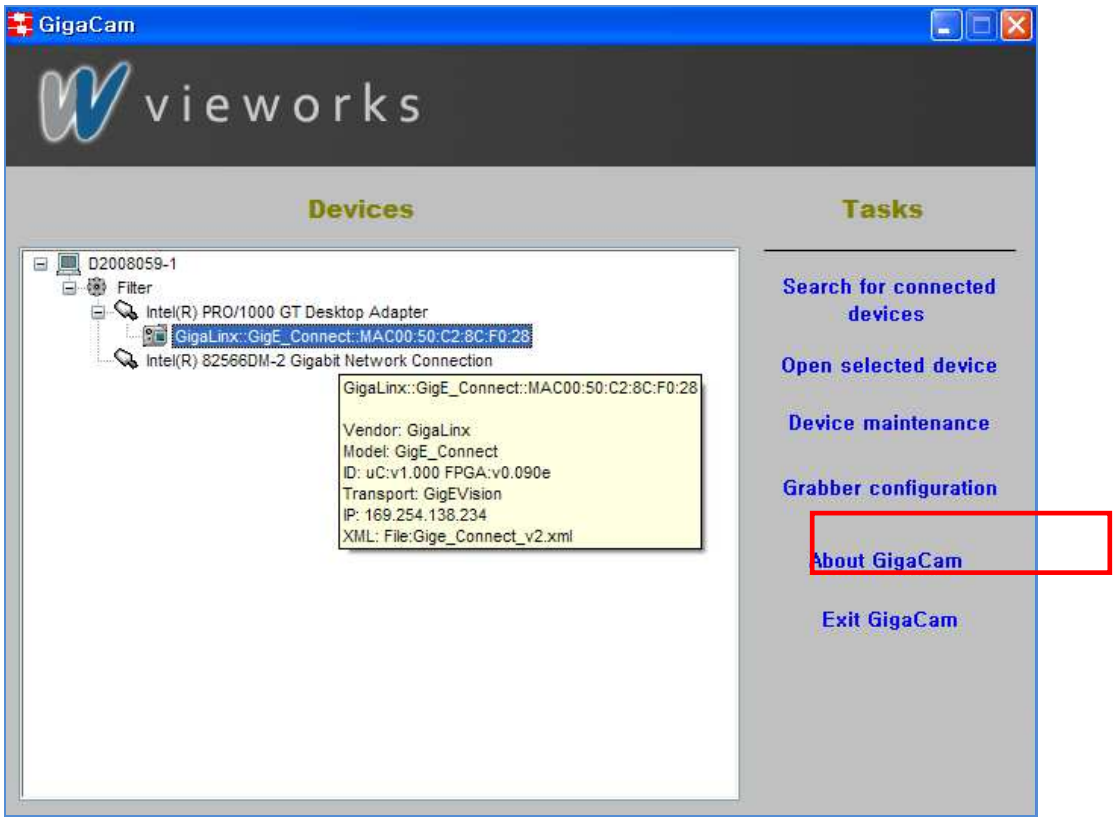
2. Select FPGA update file(*.bin) provided in File Dialog and press Open button.



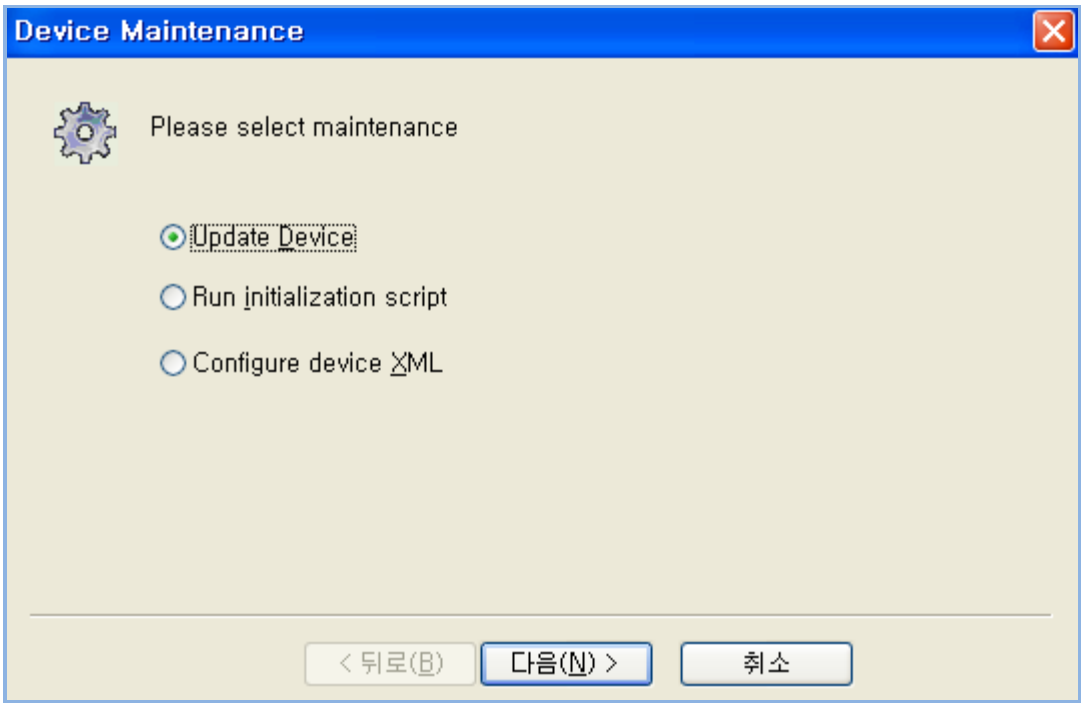
3. Subsequent process is same as that of MCU upgrade.

C.3.1 GigE (MCU & FPGA)

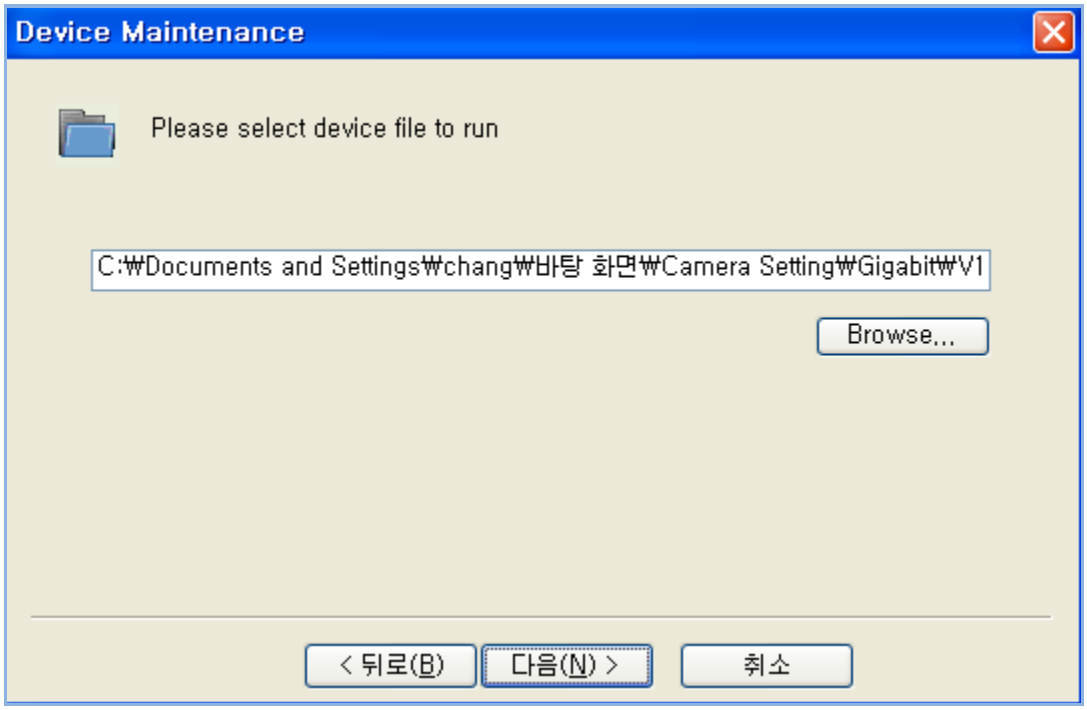
1. Select Device Maintenance



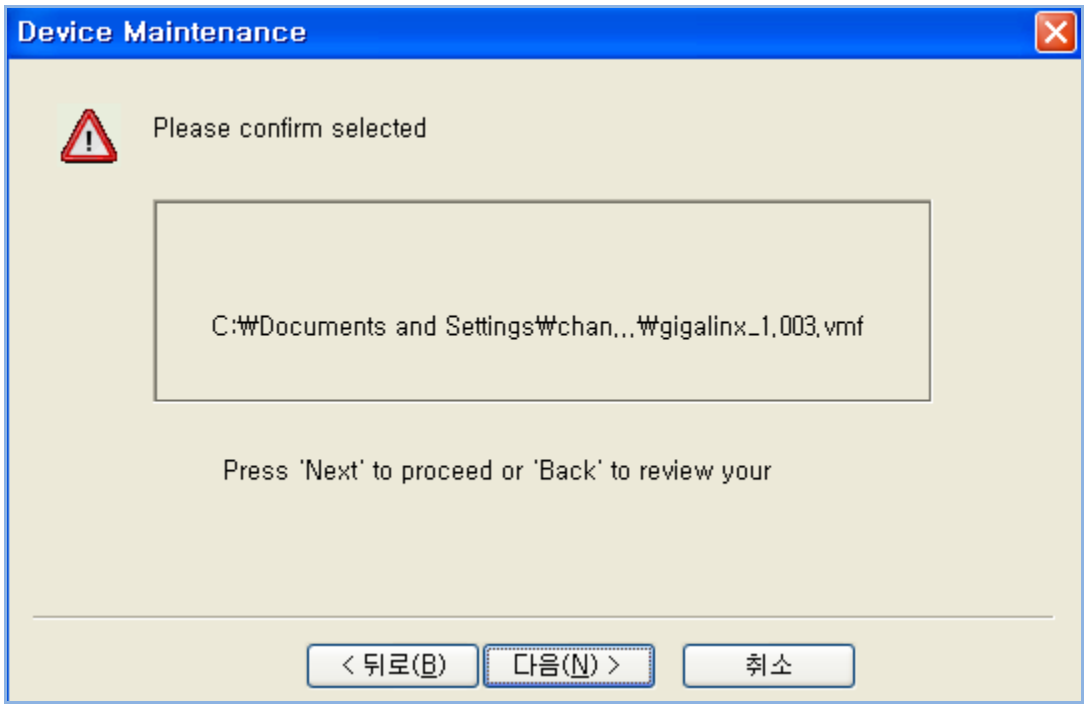
2. Select Update Device



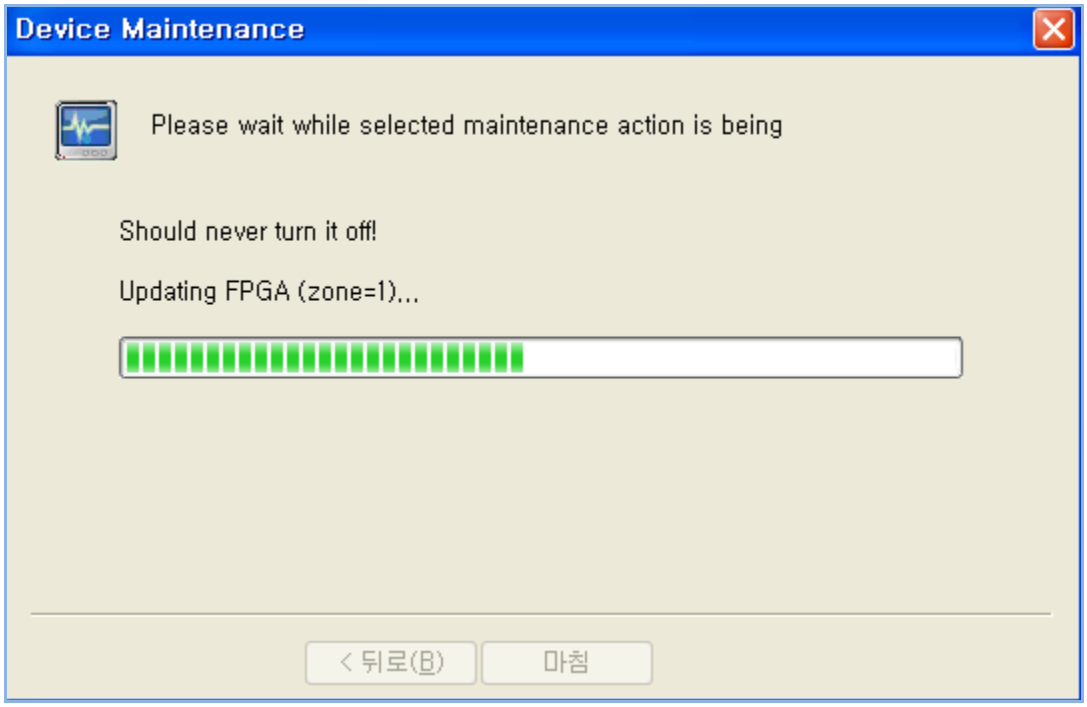
3. Designate path for destination file



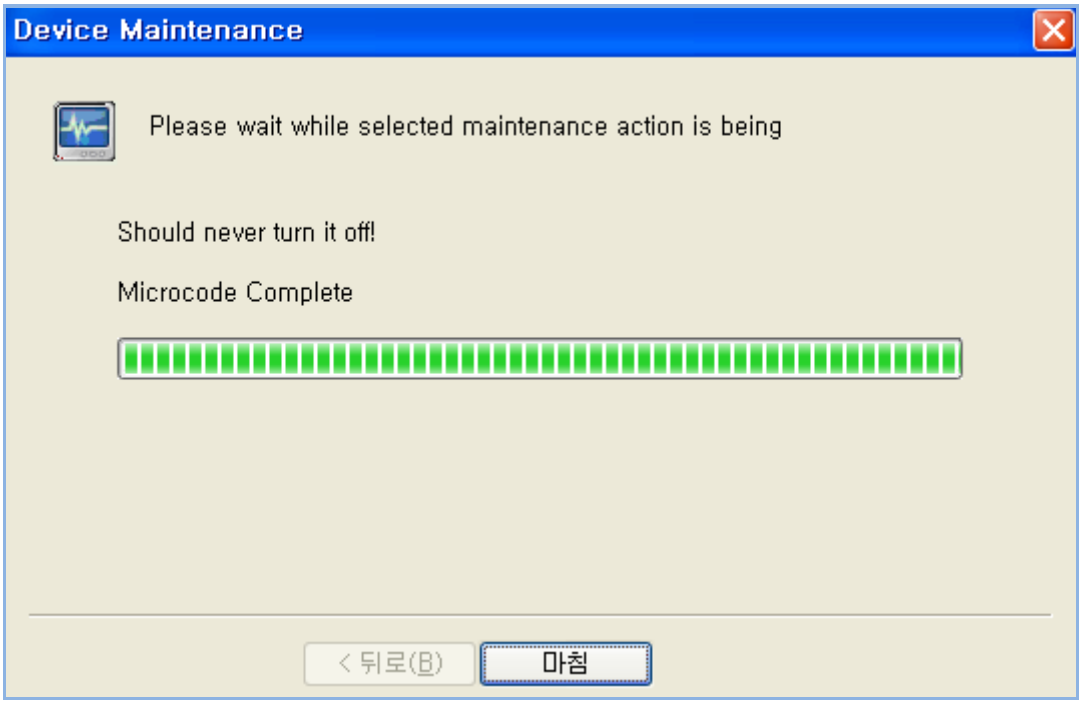
4. Check Path



5. Upgrade



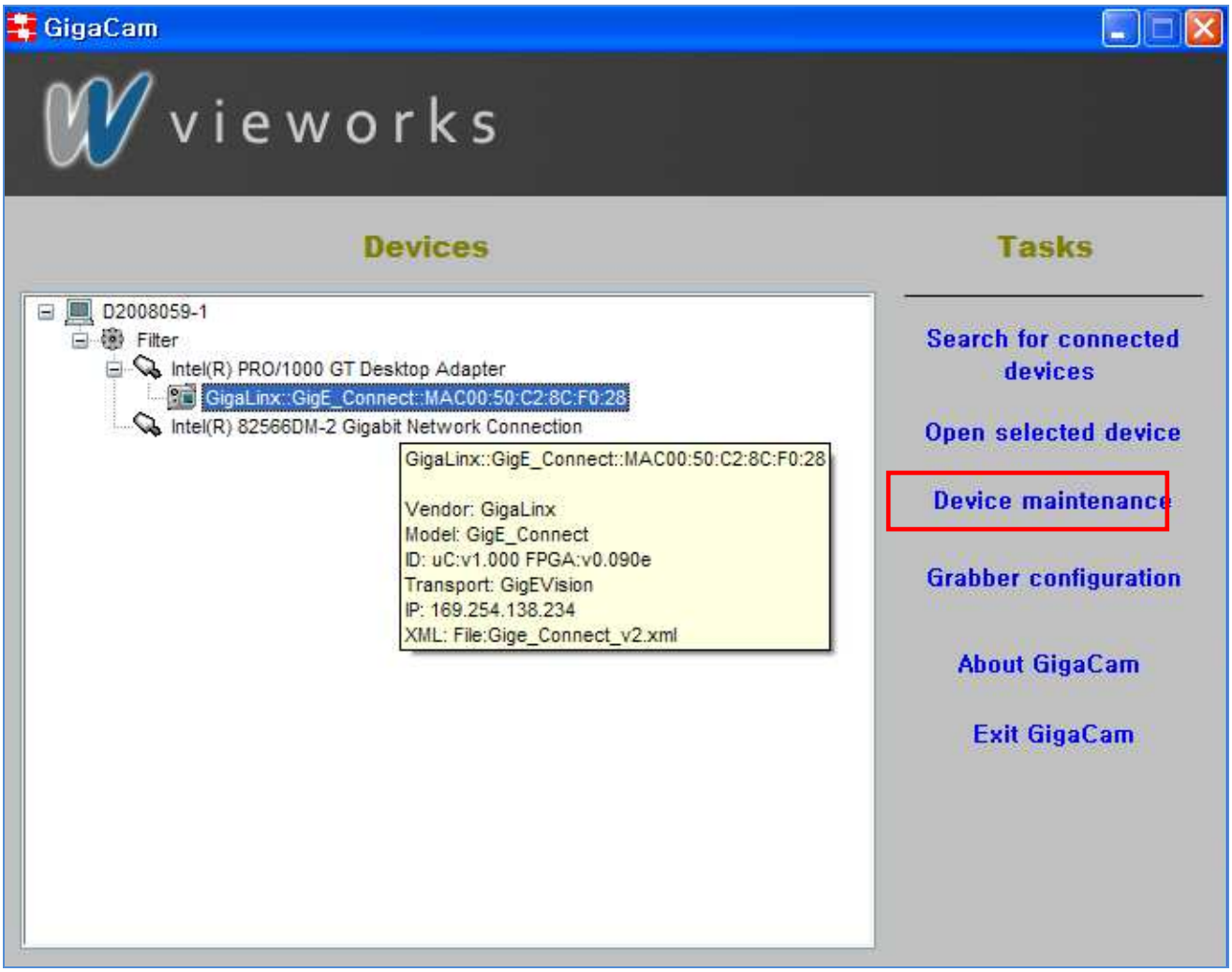
6. Finish Upgrade



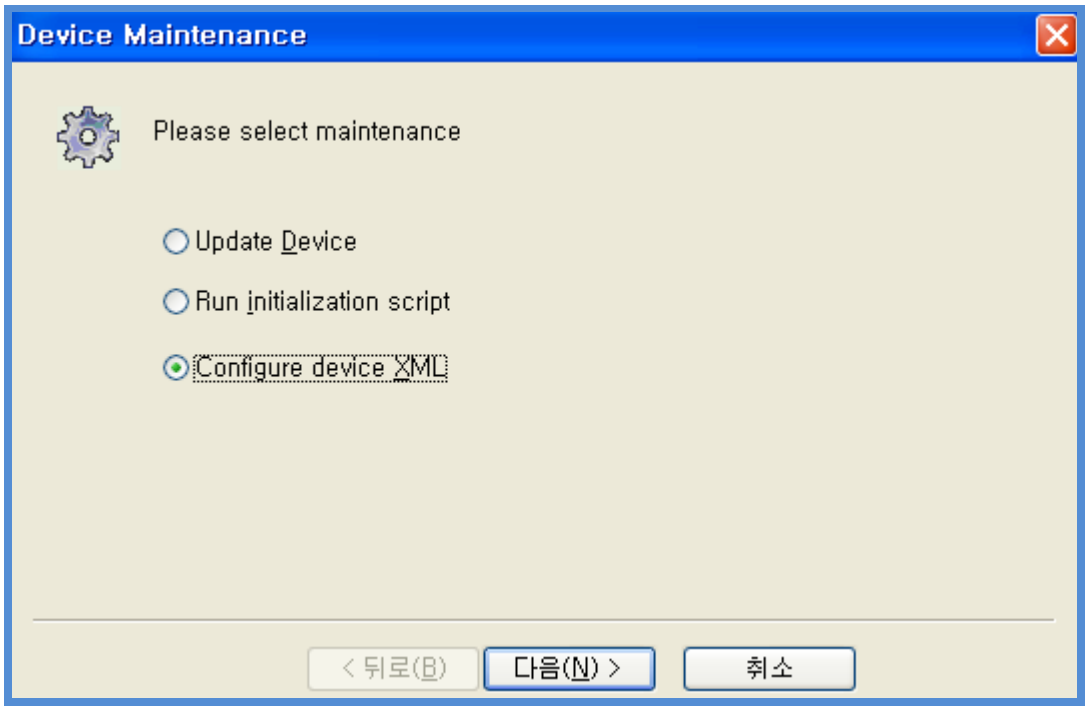
- Finish
- Power off -> on

C.3.2 GigE (XML file)

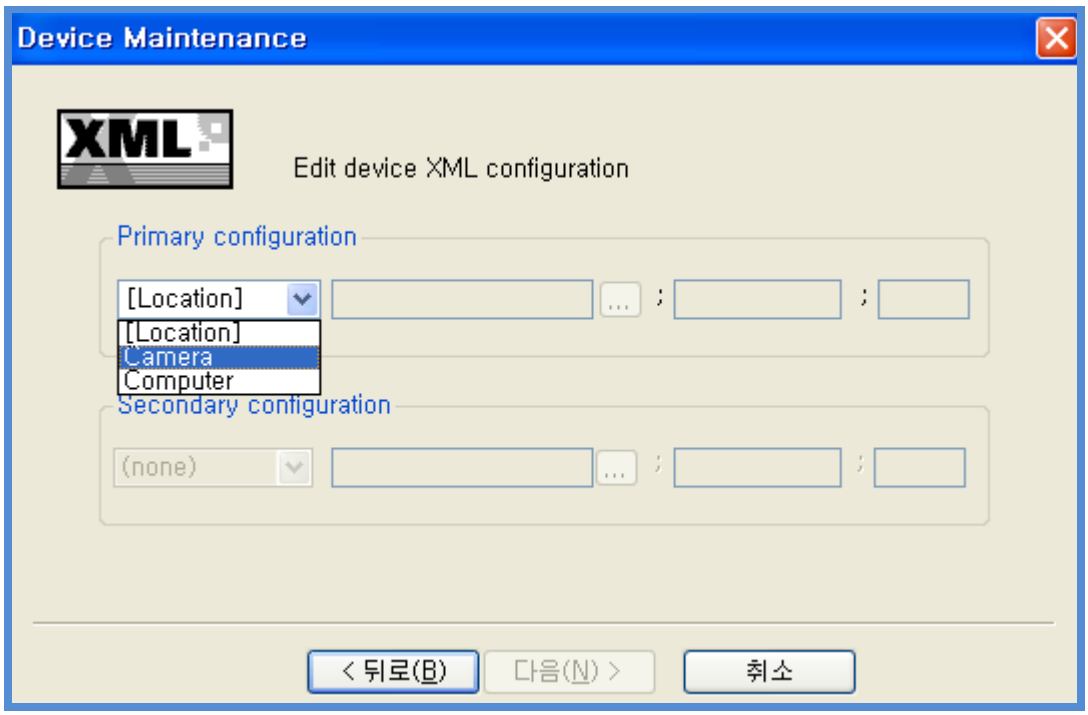
1. Select Device maintenance



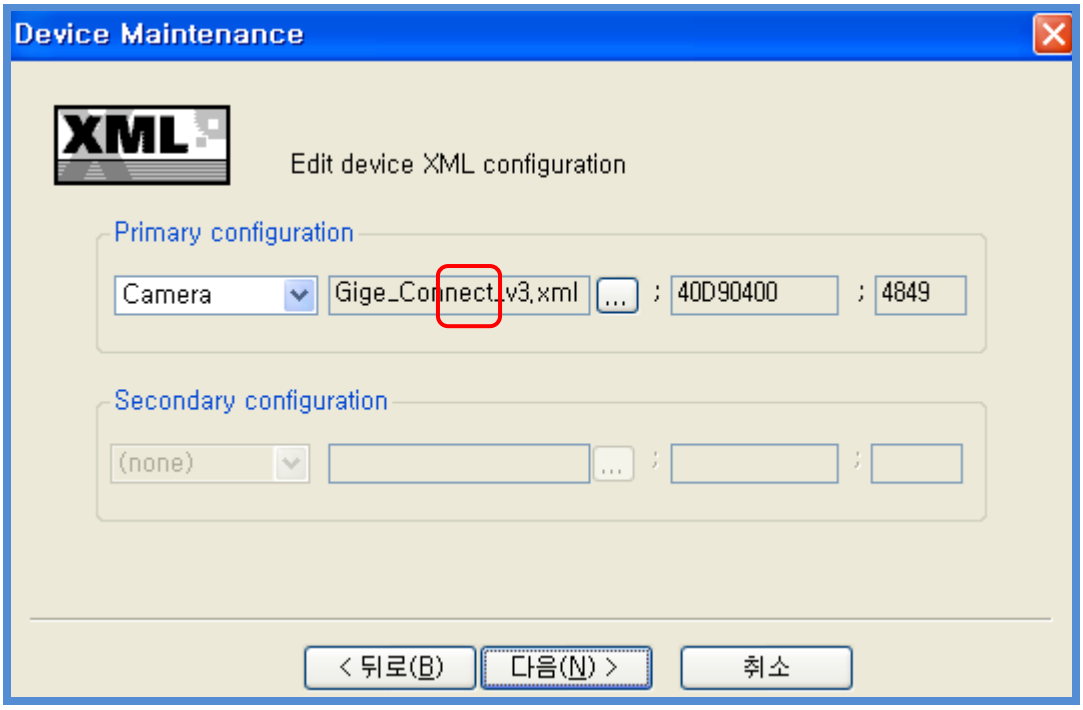
2. Select Configure device XML



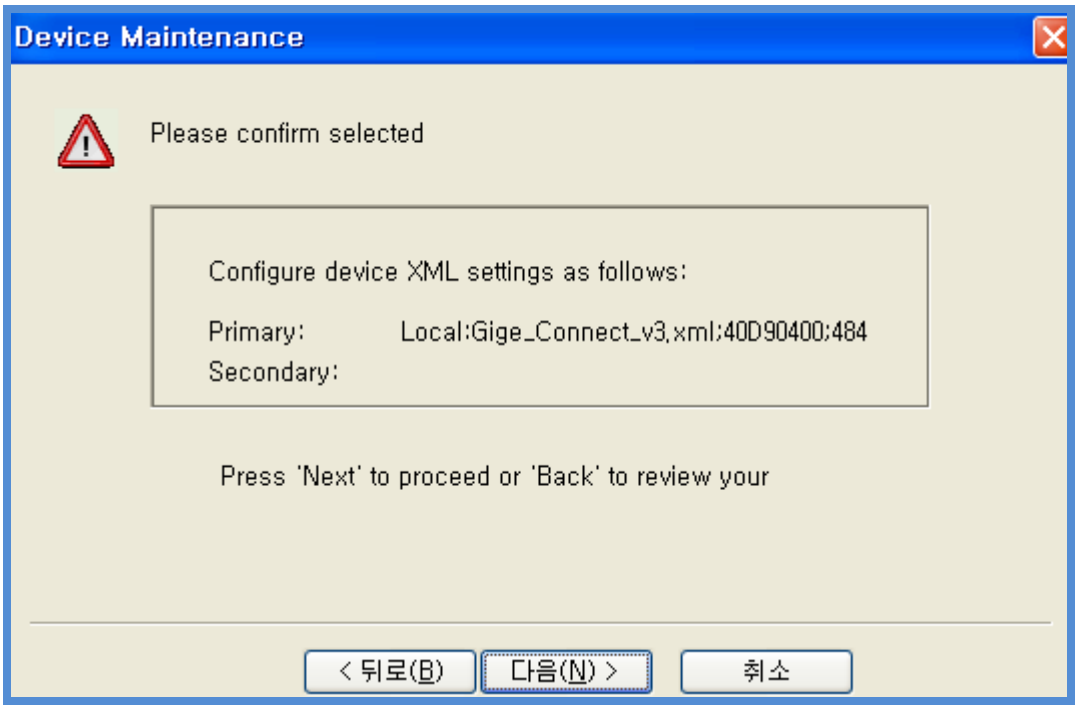
3. Select [Location] Camera



4. Designate XML file path



5. Check Setting value



6. Finish Upgrade